DOCKETED	
Docket Number:	79-AFC-05C
Project Title:	Compliance - Application for Certification for PG&E Geysers Unit 16 (78-NOI-6)
TN #:	242580
Document Title:	2020 Revised Annual Compliance Report - Quicksilver
Description:	N/A
Filer:	Sharon Peterson
Organization:	Geysers Power Company, LLC
Submitter Role:	Applicant
Submission Date:	4/5/2022 5:05:07 PM
Docketed Date:	4/5/2022

CALPINE

GEYSERS POWER COMPANY, LLC

10350 SOCRATES MINE ROAD

MIDDLETOWN, CA 95461

GPC-22-063

April 5, 2022

Eric Veerkamp, Compliance Project Manager
Energy Facilities Siting and Environmental Protection Division
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, California 95814-5512

Subject: 79-AFC-05C REVISED 2020 Annual Compliance Report – Unit 16 (Quicksilver) Power Plant

Dear Mr. Veerkamp:

In fulfillment of the Compliance Plan's annual reporting requirement, Geysers Power Company, LLC hereby submits the following revised 2020 Annual Compliance Report (ACR) for Unit 16 (Quicksilver). This ACR supersedes the previous 2020 ACR that was docketed on 12/20/2021 (TN# 240997).

If you have any comments or questions, please contact me at (707) 431-6858.

Sincerely,

Sharon Peterson
Air Compliance Manager, Geysers
Calpine Corporation

Geysers Quicksilver Plant (Unit 16)
79-AFC-05C
2020 Annual Compliance Report to the California Energy Commission (Rev.1)
January 2020-December 2020 Reporting Period

EXECUTIVE SUMMARY

Section 25532 of the Public Resources Code provides that the California Energy Commission (CEC) shall establish a monitoring system to assure that any facility certified by the CEC is constructed and operated in compliance with air, water quality, public health, safety, and other applicable regulations, guidelines, and conditions adopted or established by the CEC.

On December 4, 1979, Pacific Gas and Electric Company (PG&E) filed an Application for Certification (AFC) for Geysers Power Plant Unit 16. In granting the AFC, the CEC issued the "Final Commission Decision Document for Geysers Power Plant Unit 16." In November 1999, the CEC license was transferred from PG&E to Geysers Power Company, LLC (GPC or Project Owner). The license requires GPC to be responsible for administering and monitoring various Conditions for Certification as contained in the Final Commission Decision, in accordance with the Compliance Plan for Unit 16, including submitting an Annual Report that summarizes compliance tasks conducted during the previous year.

Two amendments to the Final Decision have been approved by the CEC, resulting in the inclusion of additional on-going compliance tasks for reporting in the Annual Compliance Report.

First, on December 10, 2018 the CEC Final Decision was amended to revise the Air Quality Conditions of Certification and approved the installation of the wet down system permanent diesel engine at Grant, Socrates and Quicksilver (TN#: 226127). The new Air Quality and Worker Safety Conditions of Certification requires on-going reporting of certain monitoring and other activities at Grant.
Second, on November 16, 2020, additional Compliance Conditions of Certification were adopted for Unit 19 (TN#: 235706): GEN-1, COM-1 through 11, and FIRE PROTECTION-1 through 5. Condition COM-5 requires submission of Periodic and Annual Compliance Reports and details specific reporting requirements that should be included in each Annual Compliance Report (ACR). The following sections of this ACR corresponds with the reporting requirements set forth in Condition COM-5. The conditions with annual reporting requirements that are included as part of this ACR are summarized below:

Technical Area	Conditions with Annual Reporting Requirements
Air Quality	AQ-5C, AQ-5E, AQ-E3E, AQ-SC2, AQ-SC3
Biological Resources	BR 1-3
Compliance	COM-5
Fire Protection	Fire Protection-3
Public Health	PH 6-1
Water Quality, Hydrology and Water Resources	WQ 11-10

In accordance with Condition Compliance-5, the Project Owner reports as follows:

1. Updated Compliance Matrix

A copy of the updated compliance matrix showing the status of all conditions of certification (with the exception of fully satisfied conditions) is included as an attachment under COMPLIANCE-5.

Geysers Quicksilver Plant (Unit 16)

79-AFC-05C

2020 Annual Compliance Report to the California Energy Commission (Rev.1)

January 2020-December 2020 Reporting Period

2. Summary of current project operating status and explanation of any significant changes to facility operating status during the year

Quicksilver is currently operational and was operational during the 2020 reporting period with the exception of the following outage periods:

Event	Summary	Start	Actual End
Planned Outage, Transmission supplier	PG&E 230 kv line outage	6/25/2020 4:30	6/25/2020 20:50
Planned Outage, Transmission supplier	PG&E 230 KV line work	1/21/2020 2:00	3/1/2020 16:45
Planned Outage, Transmission supplier	PG&E 230 kv line outage	11/6/2020 4:30	11/6/2020 19:15
Forced Outage, Transmission supplier	Unit removed from service in preparation for Transmission System Operator PSPS event	10/25/2020 0:00	10/28/2020 4:20
Forced Outage, Transmission supplier	Lightning strike to 230KV line	8/16/2020 5:15	8/16/2020 17:50

Geysers Quicksilver Plant (Unit 16)

79-AFC-05C

2020 Annual Compliance Report to the California Energy Commission (Rev.1)

January 2020-December 2020 Reporting Period

3. Required Annual Compliance Report Documents

The following documents are required by specific conditions to be submitted along with the ACR:

Condition of Certification	Submittal Title
AQ-5C	**Attachment AQ-5C:** Summary of H2S source test results for the 2020 calendar year The 2020 AB2588 Air Toxics "Hot Spots" Emission Inventory Report (electronic .tra file) was provided to LCAQMD on 4/29/2021.
AQ-5E	The gland steam seal system annual test was conducted on 6/17/2020 with a result of 0 ppmw H2S
AQ-E3E	**Attachment AQ-E3E**: Engine operating data summary for the 2020 calendar year
AQ-SC2	**Attachment AQ-SC2:** Copy of the Annual Throughput Report submitted to LCAQMD for the operating period October 1, 2019 through September 30, 2020
AQ-SC3 / COM-5	**Attachment COM-5:** Compliance Matrix This Annual Compliance Report is being submitted to the CEC in accordance with AQ-SC3 and COM-5. An updated Compliance Matrix is attached in accordance with COM-5.
BR 1-3	**Attachment BR 1-3a:** Aquatic Monitoring Report **Attachment BR 1-3b:** Guzzler Inspection Report
PH 2-1	**Attachment PH 2-1:** Table of quarterly radon-222 concentration analyses in non-condensable gases during the 2020 calendar year
FIRE PROTECTION - 3	Inspection, Testing, and Maintenance (ITM) reports are submitted to the CEC under confidential designation. ITM reports are not provided as part of this ACR.
WQ 11-10	**Attachment WQ 11-10:** 2020 Geysers Power Plant Units Recycled Water Use Report. A copy of the report is attached.

Geysers Quicksilver Plant (Unit 16)
79-AFC-05C
2020 Annual Compliance Report to the California Energy Commission (Rev.1)
January 2020-December 2020 Reporting Period

4. Cumulative List of All Known Post-Certification Changes Approved by the CEC or CPM

- Order approving settlement relating to fire system investigation, and adding Conditions of Certification GEN-1, COM-1 through 11, and FIRE PROTECTION-1 through 5 was approved 11/19/2020 per TN# 235706.

5. Submittal deadlines not met

There are no past due compliance submittals.

6. Filings Submitted to or Permits Issued by Other Governmental Agencies

- Quarterly Compliance Reports submitted to CEC
- Quarterly Compliance Reports submitted to LCAQMD
- Criteria Pollutant Year 2020 Emission Inventory for GPC Plants submitted to CEC
- 2020 PSD H2S Abatement System Performance Results: Geysers Power Company LLC's Sonoma, Lake View, Grant, Quicksilver and Calistoga Power Plants submitted to CEC & LCAQMD
- Lake County AB2588 Air Toxics "Hot Spots" Emission Inventory Report for the Inventory Year 2020 submitted to LCAQMD
- Monthly submission of completed hazardous waste manifests to DTSC.
- Annual Hazardous Waste Report submitted to DTSC.
- Sulfur Hexafluoride (SF6) Geothermal Resource Tracer Testing Exemption- Progress Report submitted to CARB
- Guzzler and Sediment Pond inspection pictures submitted to CEC
- BC/WFF aquatic monitoring report submitted to CEC

7. Projection of Scheduled Compliance Activities for Next Year

- AQ-5C: Perform annual comprehensive testing of incoming steam, condensate, circulating water and cooling tower stack shall be tested for H2S, ammonia, arsenic, boron, hexavalent chrome, mercury, radon 222, and particulates as appropriate.
- AQ-5E: Perform annual source testing of Gland Steam Seal System
- Biological Resources 1-3: Continued implementation and maintenance as outlined in Wildlife Mitigation Plan and Monitoring Program
- Compliance-5: Evaluate Site Contingency Plan for unplanned facility closure
- Fire Protection-3: Perform inspections, testing, and maintenance of fire systems
- Public Health 2-1: Perform quarterly sampling and analysis of radon-222 concentrations in noncondensable gases entering the power plant in the incoming steam line, or vent off-gas line, or H2S abatement off-gas line

Geysers Quicksilver Plant (Unit 16)

79-AFC-05C

2020 Annual Compliance Report to the California Energy Commission (Rev.1)

January 2020-December 2020 Reporting Period

8. Additions to the Compliance Record

- Order Approving Settlement docketed 11/19/2020 per TN# 235706
- On-going logging of monitoring and calibration of H2S monitoring devices, continuous strip chart record and appropriate sampling line, and other additions pursuant to AQ-5A.
- On-going analyses of results of source tests and other tests requested by the LCAQMD or CEC pursuant to the AQ conditions of certification.
- 2020 Geysers Power Plant Units Recycled Water Use Report to the State WRCB-Division of Drinking Water.

9. Evaluation of the Site Contingency Plan

An evaluation of the Site Contingency Plan for unplanned facility closure was conducted and minor modifications were made to the plan to update the listed agency contact information for listed to be referenced in case of a facility closure.

10. Listing of complaints, notices of violations, official warnings, and citations

No complaints, notices of violations, official warnings or citations received during the 2020 reporting period.

CONDITION OF CERTIFICATION
AQ-5C

Attachment AQ-5C: Summary of H2S source test results for the 2020 calendar year

Geysers Quicksilver Plant (Unit 16) 79-AFC-05C
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

Summary of H2S Source Test Results for the 2020 Calendar Year

Geysers Quicksilver Plant (Unit 16) 79-AFC-05 , Condition AQ-5C		
Month	**Test Date**	**Measured H_2S Emissions (Kg/hr)***
January	**1/8/2020**	**1.2**
February	**Unit 16 Out of Service**	**---**
March	**3/11/2020**	**0.5**
April	**4/2/2020**	**1.0**
May	**5/6/2020**	**0.7**
June	**6/17/2020**	**1.4**
July	**7/28/2020**	**0.6**
August	**8/11/2020**	**0.9**
September	**9/3/2020**	**0.5**
October	**10/8/2020**	**0.5**
November	**11/12/2020**	**2.2**
December	**12/9/2020**	**0.4**

*Unit 16 allowable H_2S emissions = 2.3 Kg/hr

CONDITION OF CERTIFICATION
AQ-E3E

Attachment AQ-E3E: Engine operating data summary for the 2020 calendar year

Geysers Quicksilver Plant (Unit 16) 79-AFC-05C
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

Cooling Tower Wet-down Diesel Engine-Driven Pump Operating Data
CEC Licensed Facilities in Sonoma County
January 1, 2020 - December 31, 2020

Facility	*Ultra Low Sulfur Diesel Fuel Use (Gallons)* [1]	*Engine Use (Total Hours)*	*Engine Use by Category*	*Engine Use by Category (Hours)*
Quicksilver (Unit 16) License: 79-AFC-05C Condition: AQ-E3E	210.9	17.2	Testing/Maintenance	17.2
			Emergency Use	0.0

[1] Fuel use estimated using manufacturer's fuel consumption rating x total hours of engine operation

CONDITION OF CERTIFICATION
AQ-SC2

Attachment AQ-SC2: Copy of the Annual Throughput Report submitted to LCAQMD for the operating period October 1, 2019 through September 30, 2020

Geysers Quicksilver Plant (Unit 16) 79-AFC-05C
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

GEYSERS POWER COMPANY, LLC

NYSE CPN

GPC-20-040

October 28, 2020

Douglas Gearhart
Air Pollution Control Officer
Lake County Air Quality Management District
2617 South Main Street
Lakeport, CA 95453

Attention: Elizabeth Knight, AQS

Dear Mr. Gearhart:

Subject: Annual Production 2020 Throughput Report and Full Field Survey H2S Results

Enclosed are the annual throughput reports requested in your letter dated September 1, 2020. These data are presented for the period of operations from October 1, 2019 through September 30, 2020.

The 2020 annual steam field H_2S analysis results for production wells are provided with these throughput data.

If you have any questions concerning this submittal please call me at (707) 431-6053.

Sincerely,

Brian Benn
Environmental Chemistry Manager, Geysers

Enclosure

Geothermal Power Plant Emissions/Throughput Worksheet

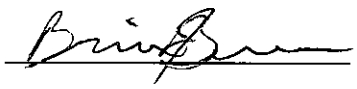
Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd.
Middletown, CA 95461

2020

		Normal Production			Stretford Bypass		Steam Stacking/Venting	
Source	**Permit #**	**Number of Hours in Production**	**Average H2S Emissions (lbs/hr)**	**H2S Emissions (lbs/yr)**	**Number of Stretford Bypass Events**	**Stretford Bypass Emissions (H2S-lbs/yr)**	**Number of Steam Stacking Events**	**Steam Stacking Emissions (H2S-lbs/yr)**
Calistoga Geothermal Power Plant	P/O 96-53D	6589.3	1.0	6,589	0	0	2	30,786
Unit 13 Geothermal Power Plant	P/O 80-001B	6589.0	2.8	18,449	0	0	2	3,192
Unit 16 Geothermal Power Plant	A/C 2015-24	8470.9	2.3	19,483	0	0	1	334
West Ford Flat Geothermal Plant Power Plant	P/O 90-050B	0	0	0	0	0	0	0

Covering the latest twelve (12) month period from October 1, 2019 to September 30, 2020

Print Name: Brian Benn Phone: (707) 431-6053

Submitted by:  Date: 10/28/20

Geothermal Steam Transmission Line Emissions/Throughput Worksheet

2020

Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd
Middletown, CA 95461

Associated Project	Source	Permit #	Number of Bleed/Vent Occurrences [1]	Total Hours on Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam (ppmw)	H2S Emissions (lbs)
Bear Canyon Creek	BCC I Unit 16 Intertie Steam	AIC 2013-21	9	9.3	125	129	11.7
Bear Canyon Creek	BCC Steam Transmission Line	P/O 90-061	0				
Unit 11/17 (North)	Binkley Steam Transmission Line	P/O 80-028	0				
Sonoma Geo	CA 1862/Sonoma Geo Steam Transmission	P/O 90-004	0				
Unit 11/17 (North)	L'Esperance Steam Transmission Line	P/O 92-006	0				
Unit #13	Unit 13/16 Intertie Steam Transmission Line	P/O 85-023	0				
Unit #13	Unit 13/18 Intertie Steam Transmission Line	A/C 2000-11	0				
Unit #13	Unit 13 Parallel Steam Transmission	A/C 2007-15A	0				
Unit #13	Unit 13 Steam Transmission Line	A/C 2017-04	2	195.1	1149	128	147.0
Unit #16	Unit 16 Steam Transmission Line System	P/O 98-20A	3	14.4	213	129	27.5
Unit 17	Unit 17/21 Intertie Steam Transmission Line	A/C 84-029	2	199.6	1176	319	375.0
Unit 11/17 (North)	Unit 17 DX Steam Transmission Line	P/O 84-007	0				
Unit 11/17 (North)	Unit 17 GDHS Steam Transmission Line	P/O 92-011	0				
Unit 11/17 (North)	Unit 17 NEGU Steam Transmission Line	P/O 92-010	0				
Unit 18 South	Unit 18 Tocher Steam Transmission Line	P/O 83-009	2	199.2	440	72	32.0
Unit 11/17 (North)	Unit 21/17 Intertie Steam Transmission Line	A/C 2001-05	0				
West Ford Flat	WFF/Calistoga Steam Transmission	A/C 2015-06	1	1.6	5	163	0.7
West Ford Flat	WFF Steam Transmission Line	P/O 90-051	0				
Calistoga	Calistoga Steam Transmission Line	P/O 85-002E	10	326.2	1606	163	264.2

Endnotes:

1. Steam transmission lines include all venting to atmosphere, clean-outs, freeze protection and condensate collection emissions.

Covering the latest twelve (12) month period from October 1, 2019 to September 30, 2020

Print Name: Brian Benn Phone: (707) 431-6053

Submitted by: Brian Benn Date: 10/28/20

Geothermal Well Emissions/Throughput Worksheet

2020

Calpine Calistoga Holdings, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd
Middletown, CA 95461

Associated Project	Source	Permit #	Status[1]	Number of Bleed/Vent Occurrences	Total Hours On Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam [2] (ppmw)	H2S Emissions [3] (lbs)
Calistoga	23-22	P/O 85-008A	SI	0				
Calistoga	23A-22	P/O 85-009A	SI	0				
Calistoga	23B-22	A/C 2005-08	P	2	2054.2	583.5	716	417.7
Calistoga	23C-22	P/O 88-084	I	0				
Calistoga	23D-22	P/O 96-10	SI	0				
Calistoga	23E-22	A/C 97-16	SI	2	2054.0	479.5	352	168.9
Calistoga	23F-22	P/O 95-09	P	1	285.9	74.0	270	20.0
Calistoga	23G-22	P/O 96-11	P	2	297.0	94.5	413	39.2
Calistoga	23H-22	P/O 96-16	P	1	2043.0	586.0	334	196.0
Calistoga	23I-22	A/C 99-09	ND	0				
Calistoga	36-22	P/O 91-012	P	4	2073.0	3927.5	39	153.1
Calistoga	36A-22	P/O 91-009	SI	0				
Calistoga	36B-22	P/O 91-010	P	3	2059.0	608.5	106	64.6
Calistoga	36C-22	P/O 93-012	P	3	2002.0	548.5	74	40.5
Calistoga	68-21	P/O 85-004A	P	2	8.0	1.8	31	0.1
Calistoga	68A-21	P/O 95-01	P	1	1.4	0.2	137	0.0
Calistoga	68B-21	P/O 85-006A	P	2	960.7	249..5	35	8.7
Calistoga	68C-21	P/O 95-02	P	2	2420.0	628.5	30	18.9
Calistoga	68D-21	P/O 86-002	P	1	2114.4	531.3	54	28.7
Calistoga	68E-21	P/O 91-011	P	1	2096.2	558.6	56	31.3
Calistoga	68F-21	P/O 96-45	P	0			30	
Calistoga	68G-21	P/O 95-05	P	2	2097.5	558.9	56	31.3
Calistoga	74-21	P/O 85-015A	SI	0				
Calistoga	74B-21	P/O 85-016A	P	1	10.0	0.5	207	0.1
Calistoga	74C-21	P/O 85-017A	P	1	10.0	0.5	68	0.0
Calistoga	74D-21	P/O 88-083	P	1	10.0	0.5	270	0.1
Calistoga	74E-21	P/O 93-002	SI	0				
Calistoga	74F-21	P/O 94-015	I	0				
Calistoga	74G-21	P/O 94-02	P	1	120.0	2400.0	136	326.0
Calistoga	74H-21	P/O 94-016	P	1	10.0	0.5	391	0.2
Calistoga	87-21	A/C 97-15	SI	0				
Calistoga	87A-21	P/O 85-012A	SI	3	1.3	11.2	25	0.3
Calistoga	87B-21	P/O 93-013	P	2	2107.0	580.6	52	30.2
Calistoga	87C-21	P/O 93-014	P	2	2107.0	570.0	254	144.7
Calistoga	87D-21	P/O 86-003	P	2	2107.0	587.6	115	67.6
Calistoga	87E-21	P/O 91-002	SI	0				
Calistoga	87F-21	P/O 91-006	SI	3	2.3	36.5	92	3.3
Calistoga	87G-21	P/O 92-015	SI	0				

Endnotes

1. (Status: P (production, I (injection, SI (shut in), ND (not drilled), B (standby bleed),... note other abbrs used.)
2. H_2S concentration of steam reported for the current year (2019) annual full field survey.
3. Steam emission occurrences which result in H_2S emissions of less than 0.05 lbs. are rounded and reported as 0.0 lb.

Covering the latest twelve (12) month period from October 1, 2019 to September 30, 2020

Print Name: Brian Benn Phone: (707) 431-6053

Submitted by: Brian Benn Date: 10/28/20

Geothermal Well Emissions/Throughput Worksheet

2020

Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd.
Middletown, CA 95461

Associated Project	Source	Permit #	Status[1]	Number of Bleed/Vent Occurrences	Total Hours On Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam [2] (ppmw)	H2S Emissions [3] (lbs)
Unit #13	Abel 1	P/O 80-009A	P	1	0.9	0.23	254	0.1
Unit #16	Barrows 2	P/O 86-052	P	2	212.9	58.2	110	6.4
Unit #16	Barrows 3	P/O 86-053	P	2	213.4	86.4	197	17.0
Unit #16	Barrows 4	P/O 86-054	SI	0				
Unit #16	Barrows 5	P/O 86-055	P	2	220.5	79.9	160	12.8
Unit #16	Barrows 6	P/O 91-016	P	2	223.7	45.6	211	9.6
Unit #16	Barrows 7	A/C 2003-06A	I	0				
Unit #13	Bianchi 3	P/O 84-004A	SI	0				
Unit 11/17 North	BRU 1	P/O 80-029	P	5	721.5	322.2	641	206.6
Unit #18 (South)	CA 1862-1	P/O 95-06	SI	0				
Unit #13	CA 1862-2	P/O 80-027A	P	1	0.9	0.2	317	0.1
Sonoma Geo	CA 1862-4	A/C 2007-04	I	0				
Unit #13	CA 956A 1 (Redrill)	A/C 2003-16	SI	0				
Unit #13	CA 956A 4	P/O 80-26A	P	1	1.4	0.3	174	0.0
Unit #16	CA 956A 5	P/O 86-059	P	2	224.5	43.9	70	3.1
Unit #16	CA 958 1	P/O 86-060	P	2	224.3	44.7	293	13.0
Unit #16	CA 958 10	P/O 85-021A	P	2	224.2	45.7	54	2.5
Unit #16	CA 958 11	P/O 86-062	P	2	224.3	48.4	40	1.9
Unit #16	CA 958 13	P/O 93-005	P	2	211.0	41.3	122	5.0
Unit #16	CA 958 5	P/O 85-019A	P	2	223.6	45.6	48	2.2
Unit #16	CA 958 6 (Injection)	P/O 86-061	SI	0				
Unit #13	CA 958 7	P/O 81-003A	P	0			212	
Unit #16	CA 958 9	P/O 85-020A	P	2	224.4	46.6	71	3.3
Unit #16	CA 958-16	P/O 93-006	P	2	224.7	46.6	150	7.0
L'Esperance	Cal State 92-6	A/C 2008-04	SI	0				
Unit #13	D&V 1	P/O 80-010A	P	1	518.2	112.0	217	24.3
Unit #13	D&V 2	P/O 80-011A	P	1	356.9	75.2	90	6.8

Geothermal Well Emissions/Throughput Worksheet

2020

Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd.
Middletown, CA 95461

Associated Project	Source	Permit #	Status[1]	Number of Bleed/Vent Occurrences	Total Hours On Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam [2] (ppmw)	H2S Emissions [3] (lbs)
Unit #13	D&V 3	P/O 80-012A	P	1	355.7	83.4	153	12.8
Unit #13	D&V 4	P/O 88-088	P	1	356.9	75.8	84	6.4
Bear Canyon Creek	Davies 5206-1	P/O 90-062	P	2	311.0	8289.0	388	321.6
Bear Canyon Creek	Davies 5206-2	P/O 90-063	P	1	3130.1	3374.6	277	934.8
Unit #16	Davies Estate 1	P/O 86-050	SI	0				
Bear Canyon Creek	Davies Estate 3	AC 17-76	SI	0				
Bear Canyon Creek	Davies Estate 4 (Injectio	AC 92-013	I	0				
Bear Canyon Creek	Davies Estate 5	P/O 90-065	SI	0				
Bear Canyon Creek	Davies Estate 6	P/O 90-066	P	5	31.7	47.8	106	5.1
Bear Canyon Creek	Davies Estate 7	P/O 90-067	P	1	1.4	0.4	197	0.1
Bear Canyon Creek	Davies Estate 8	P/O 90-068	SI	0				
Bear Canyon Creek	Davies Estate 9	P/O 91-005	P	1	14.0	5.1	229	1.2
Bear Canyon Creek	Davies State 4 (5206-4)	P/O 93-003	P	1	14.0	3.5	68	0.2
Bear Canyon Creek	Davies State 5 (5206-5)	P/O 97-01	P	2	26.5	3.3	247	1.5
Unit 11/17 North	DX-52	P/O 84-006A	SI	0				
Unit 11/17 North	DX-87	P/O 88-077	P	0			256	
Unit #13	East Ford Flat #1	P/O 93-016	P	1	0.8	0.2	231	0.0
Unit 11/17 North	GDHS 6	P/O 88-079	P	0			331	
Unit 11/17 North	GDHS 7	P/O 88-080	P	0			371	
Unit 11/17 North	GDHS 8	P/O 88-081	P	0			489	
Unit 11/17 North	GDHS 9	P/O 92-009	SI	0				
L'Esperance	L'Esperance 1	A/C 2008-05	SI	0				
Unit #13	McKinley 1	P/O 80-013A	SI	0				
Unit #16	McKinley 10	P/O 86-056	P	2	224.8	46.2	123	5.7
Unit #16	McKinley 11	P/O 93-007	P	2	223.0	45.9	111	5.1
Unit #16	McKinley 12	P/O 86-058	P	4	218.8	47.5	97	4.6
Unit #16	McKinley 13	P/O 91-013	P	5	229.3	51.0	96	4.9

Geothermal Well Emissions/Throughput Worksheet

2020

Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd.
Middletown, CA 95461

Associated Project	Source	Permit #	Status[1]	Number of Bleed/Vent Occurrences	Total Hours On Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam [2] (ppmw)	H2S Emissions [3] (lbs)
Unit #16	McKinley 15	P/O 91-014	P	2	225.9	46.8	69	3.2
Unit #16	McKinley 16	A/C 2015-01	SI	0				
Unit #13	McKinley 3	P/O 80-014A	P	2	353.7	76.9	197	15.2
Unit #13	McKinley 9	P/O 84-003A	P	1	0.8	0.1	194	0.0
Unit #13	MLM 1	P/O 80-018A	P	4	5772.8	1235.9	156	192.8
Unit #13	MLM 2 Deepening	A/C 2004-11	P	1	0.9	0.2	35	0.0
Unit #16	MLM 4	P/O 94-01	P	2	222.0	46.0	67	3.1
Unit #13	MLM 5 Fork Mod.	A/C 2004-10	SI	1	8784.0	2541.1	134	340.5
Unit #13	MLM 7	P/O 88-092	P	1	4.6	1.1	160	0.2
West Ford Flat	Moody 1	P/O 90-052	P	1	120.0	6720.0	135	907.0
West Ford Flat	Moody 2	P/O 90-053	P	0			151	
West Ford Flat	Moody 3	P/O 90-054	P	0			152	
West Ford Flat	Moody 4	P/O 90-055	P	0			132	
West Ford Flat	Moody 5	P/O 97-33	P	1	120.0	1728.0	65	112.0
Unit 11/17 North	NEGU 1	A/C 17-76-33	P	2	344.0	112.0	164	18.4
Unit 11/17 North	NEGU 10	A/C 84-041	P	0			908	
Unit 11/17 North	NEGU 13	A/C 2012-09	I	0				
Unit 11/17 North	NEGU 15	P/O 92-007	SI	0				
Unit 11/17 North	NEGU 17	P/O 92-008	P	1	714.0	206.6	229	47.3
Unit 11/17 North	NEGU 19	A/C 84-043	ND	0				
Unit 11/17 North	NEGU 20	A/C 84-044	ND	0				
Unit 11/17 North	NEGU 7A	P/O 2002-11	P	0			939	
Unit 11/17 North	NEGU 8	A/C 2004-02	P	2	277.0	126.0	757	95.4
West Ford Flat	PDC 1	P/O 90-056	P	0			223	
West Ford Flat	PDC 2	P/O 90-057	P	0			195	
West Ford Flat	PDC 3	P/O 90-058	P	0			128	
West Ford Flat	PDC 4	P/O 98-19	P	0			226	

Geothermal Well Emissions/Throughput Worksheet

2020

Geysers Power Company, LLC
c/o Calpine Corporation
10350 Socrates Mine Rd.
Middletown, CA 95461

Associated Project	Source	Permit #	Status[1]	Number of Bleed/Vent Occurrences	Total Hours On Bleed & Vent	Total Steam Vented (K-lbs)	H2S Conc. Steam [2] (ppmw)	H2S Emissions [3] (lbs)
Unit #13	Thorne 1	P/O 80-020A	P	2	353.5	91.8	231	21.2
Unit #13	Thorne 10	P/O 88-093	P	1	1.8	0.4	252	0.1
Unit #13	Thorne 3	A/C 2003-17	P	4	522.4	123.1	449	55.4
Unit #13	Thorne 5 Redrill	A/C 2007-22	I	0				
Unit #13	Thorne 6	P/O 93-009	P	2	35.1	11.0	140	1.5
Unit #18 (South)	Tocher 2	P/O 83-010	SI	0				
Unit #18 (South)	Tocher 3 Redrill	A/C 2007-27	I	0				
Unit #18 (South)	Tocher 4	P/O 91-008	P	0			117	
Unit #13	Wolfe 1	P/O 93-008	P	1	1.0	0.3	130	0.0

Endnotes:

1. Status: P (production), I (injection), SI (shut in), ND (not drilled), B (standby bleed),... note other abbrs used.
2. H_2S concentration of steam repoted for the current year (2020) annual full field survey.
3. Steam emission occurrences which result in H_2S emissions of less than 0.05 lbs. are rounded and reported as 0.0 lb.

Covering the latest twelve (12) month period from October 1, 2019 to September 30, 2020

Print Name: Brian Benn Phone: (707) 431-6053

Submitted by: Brian Benn Date: 10/28/20

Lake County Air Quality Management District
2617 South Main Street
Lakeport, CA 95453
707-263-7000 / fax 263-0421

Douglas G. Gearhart
Air Pollution Control Officer
dougg@lcaqmd.net

2020 Throughput Worksheet

(All Throughput Worksheets are Due by October 31, 2020)

Geysers Power Company, LLC

DATE: September 1, 2020

Source — Permit #

Barrows 7 — A/C 2003-06A

Unit #16 Steamfield

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

CA 1862-4 — A/C 2007-04

CA 1862-4 Padsite

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

CA 956A 1 (Redrill) — A/C 2003-16

Unit 13 Steamfield - 956A 1 Padsite

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Cal State 92-6 — A/C 2008-04

L'Esperance Padsite

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Davies Estate 3 — A/C 17-76-63B

Bear Canyon Creek Steamfield - Davies Estate 3 Padsite

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Ek 8/2020

Annual Throughput Worksheet - Continued

Source — Permit #

Diesel Engine Powered Emergency Standby Cooling Tower Wet-Down Pump — A/C 2017-49

Unit 16 Geothermal Power Plant

Note: Data not available due to PSPS - will report data on 11/2/20.

The quantity of fuel used. _____ gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Diesel Engine Powered Emergency Standby Cooling Tower Wet-Down Pump — A/C 2020-05

Calistoga Geothermal Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Diesel Fire Pump — A/C 2005-26

West Ford Flat Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Diesel Fire Pump — P/O 2014-05

Bear Canyon Creek Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Diesel Fire Pump — P/O 2016-19

Calistoga Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. 729.7 on 9/30/20 date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Emergency Backup Diesel Generator — A/C 2005-29

Unit 13 Injection Pond

See Note: above

The quantity of fuel used. _____ gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Annual Throughput Worksheet - Continued

Source — Permit #

Emergency Backup Diesel Generator — P/O 2014-03
See Note: Page 2.

Unit 16 Power Plant Vent Site

The quantity of fuel used. _____ gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Emergency Backup Diesel Generator — P/O 2005-07

West Ford Flat Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Emergency Backup Diesel Generator — P/O 2005-08

Bear Canyon Creek Power Plant

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Emergency Backup Diesel Generator — P/O 2005-09

Unit 13 Power Plant

The quantity of fuel used. _____ gallons — See Note page 2.
The type(s) of fuel used. _____
Hour meter reading. _____ on _____ date
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

L' Esperance 1 — A/C 2008-05

L'Esperance Padsite

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

McKinley 16 — A/C 2015-01

Unit 13 Steamfield

The quantity of fuel used. Ø gallons
The type(s) of fuel used. _____
The number of hours operated during the year. Ø total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

Annual Throughput Worksheet - Continued

Source	Permit #

MLM 2 Deepening and conversion to injection well — A/C 2004-11

Unit 13 Steamfield - D Line

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

MLM 5 - Fork Modification — A/C 2004-10

Unit 13 Steamfield - D Line

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

NEGU 13 — A/C 2012-09

DX Padsite

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

NEGU 8 — A/C 2004-02

NEGU 8 Padsite

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

Thorne 3 — A/C 2003-17

Unit 13 Steamfield - Well Thorne 3

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

Thorne 5 Re-Drill and Liner Installation — A/C 2007-22

Unit 13 Steamfield - B Line

The quantity of fuel used. ___Ø___ gallons
The type(s) of fuel used. _____
The number of hours operated during the year. _____ total hours
Emergency _____ hours Testing _____ hours Maintenance _____ hours

---

Annual Throughput Worksheet - Continued

Source	Permit #
Tocher 3 Re-Drill and Liner Installation	A/C 2007-27

Tocher Padsite

The quantity of fuel used. Ø gallons

The type(s) of fuel used. _____

The number of hours operated during the year. _____ total hours

Emergency _____ hours Testing _____ hours Maintenance _____ hours

Covering the period from September 1, 2019 through August 31, 2020 .

Print Name: Brian Benn Phone: 707-431-6053

Submitted By: _____ Date: 10/28/20
(signature)

Designated Non Major Stationary Source Permit to Operate, Condition 5 A
Permit # P/O 2003-04

WELL NAME	Sample Date	Time	H2S ppmw
23B-22	5/21/2020	13:58	716
23E-22	5/20/2020	9:53	352
23F-22	5/20/2020	10:02	270
23G-22	5/20/2020	10:20	413
23H-22	5/20/2020	10:14	334
36-22	5/20/2020	11:11	39
36B-22	5/20/2020	11:02	106
36C-22	5/20/2020	10:54	74
68-21	5/20/2020	11:10	31
68A-21	5/20/2020	11:27	137
68B-21	5/20/2020	11:18	35
68C-21	5/20/2020	11:03	30
68D-21	5/20/2020	11:40	54
68E-21	5/20/2020	12:10	56
68F-21	5/20/2020	11:48	30
68G-21	5/20/2020	12:16	56
74B-21	5/20/2020	10:16	207
74C-21	5/20/2020	10:05	68
74D-21	5/20/2020	9:55	260
74D-21	5/20/2020	9:55	271
74G-21	5/20/2020	10:33	136
74H-21	5/20/2020	10:41	391
87B-21	5/20/2020	11:35	52
87C-21	5/20/2020	11:43	254
87D-21	5/20/2020	11:52	114
87D-21	5/20/2020	11:52	115
ABEL1	5/6/2020	11:20	254
BARROWS2	5/11/2020	12:49	110
BARROWS3	5/14/2020	13:46	197
BARROWS5	5/14/2020	13:54	160
BARROWS6	5/11/2020	10:29	211
BRU1	5/4/2020	12:27	641
CA18622	5/6/2020	9:50	317
CA956A-4	5/6/2020	10:43	174
CA956A-5	5/11/2020	9:18	70
CA958-1	5/11/2020	10:21	294
CA958-1	5/11/2020	10:21	292
CA958-10	5/11/2020	11:01	54
CA958-11	5/11/2020	9:43	40
CA958-13	5/11/2020	9:48	122
CA958-16	5/11/2020	10:14	150
CA958-5	5/11/2020	11:24	48
CA958-7	5/6/2020	10:37	212
CA958-9	5/11/2020	10:49	71
DE6	5/13/2020	9:53	105
DE6	5/13/2020	9:53	106
DE7	5/13/2020	10:09	196
DE9	5/13/2020	10:37	229

WELL NAME	Sample Date	Time	H2S ppmw
DS1	5/13/2020	11:15	388
DS1	5/13/2020	11:15	392
DS2	5/13/2020	11:25	277
DS4	5/13/2020	10:47	68
DS5	5/13/2020	10:57	247
D&V1	5/6/2020	12:26	217
D&V2	5/6/2020	10:11	90
D&V3	5/6/2020	9:44	153
D&V4	5/6/2020	10:17	84
DX87	6/4/2020	12:59	256
EFFU1	5/6/2020	10:55	231
GDH6	6/4/2020	12:00	331
GDH7	6/4/2020	11:50	371
GDH8	6/4/2020	11:45	489
MCKINLEY10	5/11/2020	12:15	123
MCKINLEY11	5/11/2020	12:08	111
MCKINLEY12	5/11/2020	11:58	97
MCKINLEY13	5/11/2020	11:48	96
MCKINLEY15	5/11/2020	11:14	69
MCKINLEY3	5/6/2020	12:50	197
MCKINLEY9	5/6/2020	10:28	194
MLM2	5/6/2020	11:12	35
MLM4	5/11/2020	10:55	67
MLM7	5/6/2020	10:48	160
MOODY1	5/14/2020	9:24	135
MOODY2	5/14/2020	9:06	151
MOODY3	5/14/2020	8:55	151
MOODY4	5/14/2020	9:15	132
MOODY5	5/14/2020	9:44	65
NEGU1	6/4/2020	9:30	164
NEGU1	6/4/2020	9:30	161
NEGU10	6/4/2020	10:05	908
NEGU17	6/4/2020	11:23	229
NEGU7A	6/4/2020	9:58	939
NEGU8	6/4/2020	10:55	757
PDC1	5/14/2020	10:50	223
PDC2	5/14/2020	11:20	195
PDC3	5/14/2020	11:05	128
PDC4	5/14/2020	10:41	226
THORNE1	5/6/2020	12:17	231
THORNE1	5/6/2020	12:17	227
THORNE10	5/6/2020	10:40	252
THORNE3	5/6/2020	11:53	449
THORNE6	5/6/2020	9:50	138
THORNE6	5/6/2020	9:50	141
TOCH4	5/5/2020	9:40	117
TOCH4	5/5/2020	9:40	115
WOLFE1	5/6/2020	10:20	130

CONDITION OF CERTIFICATION
AQ-SC3 / COM-5

Attachment COM-5: Compliance Matrix

Geysers Quicksilver Plant (Unit 16) 79-AFC-05
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
AQ	1A	Operations/ Ongoing	The emissions limitations contained below shall apply during normal power plant operation, outages, and/or curtailments. All equipment shall be regularly maintained in good working order and operated in a manner to prevent or minimize air emissions.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance, records available upon request.
AQ	1B	Operations/ Ongoing	Hydrogen Sulfide (H2S) emissions from the project shall not exceed five (5.0) pounds per hour on a combined basis, and meet an annual performance criterion not to exceed seven and one-half (7.5) pounds per hour for an aggregate of not more than 72 hours per year.	The project owner shall verify compliance by adhering to all testing and monitoring requirements.	Ongoing	GPC is in compliance. See attached 2020 Annual Emissions Report.
AQ	1C	Operations/ Ongoing	The H2S content in the sweet gas from the Stretford shall not exceed 10 ppmv, prior to dilution in the cooling tower or as specified in an LCAQMD-approved performance plan under Section 655.	The project owner shall verify compliance by operating a continuous compliance monitor as required in AQ-5B.	Ongoing	Any H2S levels above 10 ppmv are reported in the quarterly reports.
AQ	1D	Operations/ Ongoing	The H2S concentration from the Gland Steam Seal System vent shall not exceed 250 ppmw, and the H2S emission rate shall not exceed 0.1 lbs/hr.	The project owner shall verify compliance by adhering to all testing and monitoring requirements.	Ongoing	GPC is in compliance
AQ	1E	Operations/ Ongoing	The project owner shall install and maintain cooling tower drift elimination rated at 0.002 % or better. In the event of generalized atmospheric conditions or localized dangerous contamination of such a nature as to constitute an emergency creating a danger to the health and welfare of the citizens of Lake County, the Air Pollution Control Officer (APCO) will take immediate action by requiring the project owner to reduce H2S or other emissions, or to discontinue emissions entirely. In the event emissions are discontinued entirely, a hearing shall be held by the Lake County Air Quality Management District (LCAQMD) Hearing Board, as soon as practical after such action has been taken, to determine whether such discontinuance shall continue, and under what conditions.	The project owner shall verify compliance by adhering to all testing and monitoring requirements.	Ongoing	See quarterly reports in attachment for SC-2
AQ	1G	Operations/ Ongoing	Visible emissions shall not exceed the values listed below for more than three (3) minutes in any one (1) hour: •Ringelmann 0.5 (10% opacity) for combustion emissions engine exhaust; and •Ringelmann 1 (20% opacity) for road and construction dust emissions.	The project owner shall perform a Visible Emissions Evaluation to determine compliance as requested by the LCAQMD or CPM. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	No request has been made to perform testing
AQ	2A	Operations/ Ongoing	The project owner shall maintain and operate the power plant, emissions abatement systems, and associated ancillary equipment as described in submitted specifications and drawings and subsequent permit modifications in accordance with good operating practices and procedures to meet the emissions limit in 1: Emissions. The power plant and abatement system components shall be adequately maintained and winterized.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance. Winterization inspections performed annually, records available upon request.
AQ	2B	Operations/ Ongoing	The project owner shall coordinate plant operations with the steam supplier and follow the mutually developed plan to limit H2S emissions during plant operation to the H2S emission limitation in 1: Emissions, and in the case of a power plant outage, to meet the limitation within 15 minutes or as near to 15 minutes as possible, but in no case longer than 60 minutes after the cessation of power generation. This plan, involving the operation of the turbine bypass system, shall be annually reviewed and modified as necessary with the approval of the APCO.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance. Records available upon request.
AQ	2C	Complete - report only for 2020	The Gland Steam Seal vent shall be directed upward and not be blocked from an upward trajectory by a rain cap or other means.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
AQ	2D	Complete - report only for 2020	All seal water discharged from the vacuum pumps and separators shall be directed to and flashed in the main condenser or directly re-injected. A direct re-injection line for seal water may be incorporated upon request of GST the project owner with a written approval of the LCAQMD without further permit modification.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
AQ	2E	Operations/ Ongoing	The project owner shall comply with the requirements of the Air Toxics "Hot Spots" Information and Assessment Act (AB2588) as specified in Sections 44300 - 44394 of the California Health and Safety Code.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	Submittal of the AB2588 report submitted to LCAQMD on 4/29/21 fulfills this condition. See attached for Lake County Cooling Tower Annual Injection Report
AQ	2F	Operations/ Ongoing	Within 180 days of commercial operation, the project owner shall apply for a Permit to Operate, and prove compliance with these conditions.	The project owner shall submit the Permit to Operate to the CPM as required in AQ-SC1. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Complete	Site access and records are available on request.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
AQ	3A	Operations/ Ongoing	Notification The LCAQMD shall be notified pursuant to Rule 510, upon breakdown and/or loss of emissions control from this facility. In the event that emissions exceed the allowable limit, the project owner shall notify the LCAQMD within one (1) hour and shall advise the LCAQMD: 1) the cause of the exceedance; 2) actions taken or proposed to achieve compliance; and 3) estimate of emissions and duration of noncompliance.	In the event that emissions exceed the allowable limit, the project owner shall notify the CPM by the close of the next business day. The project owner shall report breakdowns to the CPM in the quarterly compliance reports.	Ongoing	GPC is in compliance, all breakdown incidents are reported in the quarterly reports attached in SC-2.
AQ	3B	Operations/ Ongoing	Reports The project owner shall maintain records of the plant and abatement system operation, testing to show compliance with the emission limits, and provide a summary on a quarterly basis. The quarterly summary shall detail; 1) hours of operation; 2) any periods of abatement equipment malfunctions, reason for malfunction and corrective action; 3) types and amounts of chemicals used for condensate treatment; 4) periods of scheduled and unscheduled outages and the cause of outages, if known; 5) a summary of continuous emissions monitoring records for plant operation and monitor maintenance; 6) results of source tests, and 7) the dates and hours of any H2S emissions in excess of the limitation in 1: Emissions.	The project owner shall submit the quarterly reports to the CPM within 45 days of the end of each quarter. The project owner shall make the site and records available for inspection by representatives of the District, ARB, U.S. EPA, and Energy Commission upon request.	Ongoing	GPC is in compliance. See SC-2 attachments for quarterly reports.
AQ	4A	Operations/ Ongoing	Power Plant and Abatement The project owner shall submit an application for, and receive an, Authority to Construct Permit prior to any significant deletions, additions, modifications of, or operational changes to, the constructed power plant, automated (computerized) management system, and AECS equipment.	The project owner shall provide the CPM with applications and permits issued according to AQ-SC1. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	No permitting activity on power plant and abatement were completed in the reporting period.
AQ	5A	Operations/ Ongoing	Upon a determination by the APCO that continuous monitors or monitoring systems are available to quantify plant cooling tower emissions, the project owner shall install and operate a continuous emissions monitor system to verify compliance with emissions limits contained in 1: Emissions. Until such time as continuous emissions monitors are installed and operational, the project owner shall conduct monthly H2S source testing of the cooling tower stacks or as specified in an accepted performance plan under Section 655. The monthly test shall conform to source tests submitted to meet AFC Condition (K) and DOC Condition 11A.	The project owner shall submit the testing results to the CPM in the quarterly compliance report. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	Continuous monitoring systems are installed at Unit 16 and monthly H2S source tests are submitted in the quarterly reports.
AQ	5B	Operations/ Ongoing	The project owner shall maintain a continuous H2S monitor and record of gas flow on the Stretford treated gas stream. Such equipment shall be maintained in calibration and records of calibration shall be available to the LCAQMD upon request.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance, records available upon request.
AQ	5C	Operations/ Ongoing	The project owner shall annually conduct a comprehensive emissions test. The incoming steam, condensate, circulating water and cooling tower stack shall be tested for H2S, ammonia, arsenic, boron, hexavalent chrome, mercury, radon 222, and particulates as appropriate. The APCO or CPM may request analysis for additional components and testing at other process points upon reasonable request and in a manner necessary to comply with AB 2588 or other applicable law(s). The annual test plan shall be submitted for LCAQMD review and approval 45 days prior to the planned test. The results of the test shall be provided to the LCAQMD within 60 days of the completion of the test, or as soon as practicable.	The project owner shall provide the CPM a copy of the approved annual test plan. The project owner shall summarize compliance in the Annual Compliance Report. The CPM shall provide the project owner with any requests for analysis of additional components or other process points at least 60 days prior to the next scheduled test or other timeframe as agreed upon between the project owner and CPM. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC fulfills this condition through submittal of the AB2588 Air Toxics "Hot Spots" Emission Inventory Report. The 2020 report was prepared in CARB's HARP reporting software and the .tra electronic file was provided to LCAQMD on 4/29/2021. The constituents are reported as drift in the report. H2S is tested monthly and reported in the quarterly reports. The monthly H2S test results are provided as attachment AQ-5C.
AQ	5D	Operations/ Ongoing	The project owner shall fund, participate in, or cause to be performed ambient monitoring for H2S, wind speed and direction, temperature and rainfall at a location within the Anderson Springs area approved by the APCO for the operational life of the plant. The project owner shall participate in, fund, or cause to be performed, additional ambient monitoring as reasonably requested by the APCO upon determination that plant emissions are an air quality concern. The H2S and meteorological data shall be immediately available to the LCAQMD and data reports, in a format acceptable to the LCAQMD, shall be submitted on a quarterly basis. A joint monitoring effort on an equitable basis with other developers such as GAMP shall be acceptable. Upon written request of the APCO or CPM, the project owner shall install, operate and maintain a meteorological monitoring station at the power plant site. It shall be located, the results reported, and access to data provided as determined by the APCO.	If the project owner does not participate in GAMP, the project owner shall submit to the LCAQMD and CPM, for their review and approval, a detailed ambient monitoring plan.	Ongoing	GPC participates in GAMP

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
AQ	5E	Operations/ Ongoing	Source testing of the Gland Steam Seal System, as approved by the APCO, shall be performed annually unless waived in writing by the APCO.	The project owner shall submit the annual testing results or waiver to the CPM in the following quarterly or annual periodic compliance report. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance.
AQ	6A	Operations/ Ongoing	The project owner shall provide safe access to the plant records, logbooks, equipment, and sampling ports, for the purpose of inspection and testing by the LCAQMD, its representatives, the Energy Commission, or the California Air Resources Board. Should the plant be secured by locks or gates, the LCAQMD shall be provided keys, combinations or other means to gain immediate access for purpose of testing or inspection.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance
AQ	E1A	Operations/ Ongoing	All equipment shall be regularly maintained in good working order pursuant to manufacturer's guidelines and operated in a manner to prevent or minimize air emissions. The Lake County Air Quality Management District(LCAQMD) shall be notified pursuant to Rule 510, regarding equipment breakdown.	The project owner shall notify the CPM of breakdowns in the quarterly compliance reports. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC verifies compliance by adhering to all testing, monitoring, and reporting requirements.
AQ	E1B	Operations/ Ongoing	Visible emissions from E1 shall not exceed Ringelmann 0.5 (10% opacity) from the engine exhaust stack for more than three (3) minutes in any one (1) hour.	The project owner shall perform a Visible Emissions Evaluation to determine compliance as requested by the LCAQMD or CPM. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	No request has been made to perform testing
AQ	E2A	Operations/ Ongoing	E1 shall only operate to power emergency standby cooling tower wet-down pump use when commercial line power is not available because of an emergency or line maintenance outage. The project owner shall develop or utilize an engine maintenance plan per manufacturer's specifications and/or the National Emission Standard for Hazardous Air Pollutants (NESHAP) for Reciprocating Internal Combustion Engines (RICE) and New Source Performance Standards (NSPS).	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	The engine is operated only for emergency use. Testing and maintenance is limited in accordance to RICE and NESHAP regulations. Records Available upon request
AQ	E2B	Operations/ Ongoing	Testing and maintenance operations for E1 is allowed for up to 50 hours per 12-month period.	The project owner shall maintain logs as required in Records and Reporting. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance, records available upon request.
AQ	E2C	Operations/ Ongoing	Should total hours of operation for E1 exceed usage hours that result in a prioritization score of 10 or above, a Health Risk Assessment and/or additional emission reductions may be required.	The project owner shall perform a Health Risk Assessment or reduce emissions as requested by the LCAQMD or CPM. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	No request has been made to perform a Health Risk Assessment during the reporting period.
AQ	E2D	Operations/ Ongoing	Diesel fuel utilized shall be California Low Sulfur Diesel containing less than 15 ppmw sulfur.	The project owner shall maintain logs as required in Records and Reporting. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC contracts with vendors who only supply CARB diesel fuel. Records are available upon request.
AQ	E2E	Operations/ Ongoing	The project owner shall comply with the requirements of the Air Toxics "Hot Spots" Information and Assessment Act as specified in Sections 44300 - 44394 of the California Health and Safety Code as well as the ATCM for Stationary Compression Ignition Engines.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	2020 AB2588 annual update files were exported from HARP and provided to LCAQMD on 4/29/2021
AQ	E2F	Operations/ Ongoing	Within 180 days of initial operation, the project owner shall apply for a Permit to Operate, and prove compliance with these conditions.	The project owner shall submit the Permit to Operate to the CPM according to AQ-SC1. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Complete	Site access and records are available on request.
AQ	E3A	Operations/ Ongoing	The project owner shall maintain a log for E1 (all logs can be hard copy or digital) meeting the requirements of the NESHAP for RICE and NSPS which contains at a minimum, the facility name, location, engine information, fuel used, emission control equipment, maintenance conducted on the engine, and documentation that the engine meets the emission standards.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance, records available upon request.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
AQ	E3B	Operations/ Ongoing	The project owner shall maintain a log for E1 of usage that shall document hours of operation, and initial startup hours. The project owner shall maintain a log of engine maintenance to show compliance with maintenance plan and NSPS requirements.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance, records available upon request.
AQ	E3C	Operations/ Ongoing	The project owner shall document fuel usage by retention of fuel purchase records or by other methods that adequately show fuel use for this engine. Log entries shall be retained for a minimum of 36 months, with 24 months of the most recent entries retained / accessible on-site. The log shall meet all requirements of the ATCM for Stationary Compression Ignition Engines.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance. Records available upon request.
AQ	E3D	Operations/ Ongoing	The project owner shall maintain a non-resettable hour meter for each engine capable of displaying 9,999 hours.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance.
AQ	E3E	Operations/ Ongoing	The project owner shall furnish an annual record of fuel use (gallons) and owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request engine use (hours), breaking down hours of testing, maintenance, and emergency use, and in a format acceptable to the LCAQMD, within 15 days of request, and by October 31st of each year.	The content and format of the annual record submitted by the project owner to the LCAQMD shall be approved by the LCAQMD. The project owner shall provide the CPM a summary of the type of fuel used and engine use (hours) breaking down hours of testing, maintenance, and emergency use, to the CPM in the annual compliance report. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	Reporting of engine hours will be provided annually as an attachment in the ACR per Eric VeerKamp, CPM request by email to Sharon Peterson on 2/24/2022. See attachment AQ-E3E.
AQ	E4A	Operations/ Ongoing	Emergency Engine The project owner shall apply for and receive an Authority to Construct permit prior to the addition of new equipment or modification of permitted equipment.	The project owner shall provide the CPM with applications and permits issued according to AQ-SC1. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance.
AQ	E5A	Operations/ Ongoing	The project owner shall provide safe access to the plant records, logbooks, equipment, and sampling ports, for the purpose of inspection and testing by the LCAQMD, its representatives, the Energy Commission, or the California Air Resources Board. Should the plant be secured by locks or gates, the LCAQMD shall be provided keys, combinations or other means to gain immediate access for purpose of testing or inspection.	The project owner shall perform monitoring and testing as requested by the LCAQMD or CPM, the project owner shall make the site and records available for inspection by representatives of the District, ARB, U.S. EPA, and Energy Commission upon request.	Ongoing	No complaints received in during the reporting.
AQ	E6A	Operations/ Ongoing	Emergency Engine The permit for the emergency engine shall be posted at the equipment site and be available for the project owner's reference and LCAQMD staff inspection. If locks or unmanned gates are used to secure the project area, the LCAQMD or its representative will be given free access of entry for the purposes of monitoring or inspecting during normal business hours or periods of emergency engine use.	The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance.
AQ	F1A	Operations/ Ongoing	The total ROG, PM10, SOx or NOx emission rate for this facility shall not exceed 25 tons per 12-month period. The emission rate(s) determination shall be consistent with the methodology and assumptions used to evaluate the application(s) under which the LCAQMD permit(s) was/were issued.	The project owner shall perform a source test to verify compliance with the emission rate(s) upon request of the District. The project owner shall make the site and records available for inspection by representatives of the District, ARB, and Energy Commission upon request.	Ongoing	GPC is in compliance.
AQ	SC1	Operations/ Ongoing	The project owner shall provide the compliance project manager (CPM) copies of any Lake County Air Quality Management District-(LCAQMD or District) issued project air permit for the facility. The project owner shall submit any request or application for a new project air permit or project air permit modification to the CPM.	The project owner shall submit any request or application for a new project air permit or project air permit modification to the CPM at the time of its submittal to the permitting agency. The project owner shall provide the CPM a copy of all issued air permits, including all modified air permits, to the CPM within 30 days of finalization.	Ongoing	No request has been made to perform testing during the reporting period
AQ	SC2	Operations/ Ongoing	The project owner shall provide the CPM with copies or summaries of the quarterly and annual reports submitted to the District or ARB. The project owner shall submit to the CPM in the required quarterly reports a summary of any notices of violation and reports, and complaints relating to the project.	The project owner shall provide the reports to the CPM within the timeframes required in the conditions of certification.	Ongoing	See attachment AQ SC-2 for a copy of the Annual Throughput Report submitted to LCAQMD. For the Quarterly Reports, the CPM is provided with a copy at the time of submittal to LCAQMD.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
AQ	SC3	Operations/ Ongoing	The project owner shall provide the CPM with an Annual Compliance Report demonstrating compliance with all the conditions of certification as required in the General Provisions of the Compliance Plan for the facility.	The project owner shall provide the Annual Compliance Report to the CPM within 45 calendar days after the end of the reporting period or a later date as approved by the CPM.	Ongoing	GPC is in compliance
Biological Resources	1-2	Operations/ Ongoing	Project owner will implement the biological protection measures outlined in the NOI, pp. 23, 116-117, 156-161, Appendix D, Section 7, Appendix E, pp. E-54 to E-56, Appendix I, pp. 4-1 to 4-2; AFC, pp. 6-26, 6-30 to 6-32; and Responses to Data Requests of April 9, 1980, and April 30, 1980. These measures include: • The use of native species of shrubs and trees whenever possible for revegetation. • The construction of a retention barrier surrounding Unit 16 to contain accidental spills of condensate and chemicals in storage areas. • No construction within 500 feet of streams, in order to protect riparian areas, except in areas of creek crossings and fill areas as designated in construction plans or as required by the AFC approval. • The construction of the cooling tower for Unit 16 to meet a 0.002 percent drift design as an expected measure to reduce boron drift impacts on surrounding vegetation. • Evaluation of fish populations and stream sediments if a spill occurs at Unit 16. • Planning of construction to avoid mass grading during the months of December, January, and February. However, if weather conditions are favorable and PG&E desires to carry out operations during the wet season (November, December, January, February, and March), they will notify the Lake County Building Department and receive its concurrence. Extra effort to control erosion and sedimentation will be initiated during this time period, and these measures will be specified in the notification to the county. In addition, PG&E will notify the CEC and CDFandG of such construction activities and the erosion control measures to be implemented. • The use of temporary erosion control measures during construction. • The use of long-term erosion measures. • Revegetation will be used to control erosion, including punched straw seed bed preparation, hydroseeding, slope stepping, and, if necessary, establishment of an irrigation system for vegetation on cut and fill slopes and the sedimentation ponds. These efforts will be continued as needed for the duration of the project. • Revegetation shall be performed at the beginning of or just prior to the wet season, October through April, to aid in seedling survival. • Construction of sedimentation ponds at the end of the power plant site drainage system and at the disposal fill area. These ponds will be maintained for the operational life of the power plant.	Project owner will submit semiannual compliance statements, verifying compliance at biological protection measures associated with power plant construction. These statements will be submitted to the California Department of Fish and Game and the CEC starting six months after the start of construction and continuing until one year after the start of commercial operations. Starting one year after commercial operation, annual compliance statements will be re submitted to the CDFandG and the CEC/for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by project owner and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission. In the event of a spill at Unit 16, an early assessment by the project owner biologist on the immediate effects to fish populations and other stream organisms will be made and reported to the CEC and CDFandG. This will be followed by submittal of a summary report within two weeks of the spill if adverse effects occurred to biological resources.	Ongoing	GPC is in compliance
Biological Resources	1-3	Operations/ Ongoing	Project owner shall implement the measures of the CEC-CPM approved Wildlife Mitigation Plan and Monitoring Program. This plan shall discuss wildlife food planting, vegetation, wildlife ponds, wildlife habitat, erosion control, and chaparral management. Any changes or alternatives to the content of the Wildlife Mitigation Plan and Monitoring Program must be approved by the CEC-CPM. Project owner's biologist shall provide a progress report of the measures identified above to the CEC-CPM and the California Department of Fish and Game in annual compliance reports.	Prior to implementation of alternatives to the Wildlife Mitigation Plan and Monitoring Program, project owner will submit any proposed alternatives to the CEC-CPM for approval. project owner shall submit annual compliance statements to the CEC-CPM.	Ongoing	GPC is in compliance - see attached Aquatic Monitoring and Guzzler Inspection reports.
Biological Resources	1-5	Complete - report only for 2020	Project shall continue the aquatic biological resource studies in Bear Canyon Creek to monitor the effects of construction and operation of Unit 16. The studies will include water quality measurements, fisheries' populations studies, and sedimentation studies. The monitoring studies will include fish sampling to investigate rainbow trout spawning activity, and selected stream habitat parameters during the spring and summer, and quarterly sampling of streambed sediments. Further monitoring shall begin at the start of construction and continue with the same sampling frequency through the construction period and for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by Project owner and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission. The details of the baseline study and the monitoring studies have been presented in the NOI, Appendix E, and AFC, Response 31, April 9, 1980. (This monitoring program will be superseded by the KGRA-ARM study now being developed by PG&E, CEC, and other concerned parties, at the time it is implemented).	.... Starting one year after commercial operation begins, annual compliance statements will be submitted to the CDFandG and the CEC for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by project owner and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
Biological Resources	1-6	Complete - report only for 2020	Plant species of special concern have been reported near the fill site area (AFC, Vol. I, pp. 6-32). A serpentine outcropping just above the western edge of the fill site supports populations of jewel flower (Streptanthus breweri), Jepson's ceanothus (Ceanothus jepsonii), and cliff brake (Onychium densum). PG&E shall place a fence, prior to the start of construction, around the vegetation on the serpentine outcropping to help avoid accidental disturbance by construction activity.	Project owner shall notify the CDFandG and the CEC when the fence has been constructed. The protected area will be monitored by the designated biologist, and progress reports on the protected area will be included in the semiannual compliance statements verifying compliance of biological protection measures associated with power plant construction. These statements will be submitted to the California Department of Fish and Game and the CEC starting six months after the start of construction and continuing until one year after the start of commercial operations. Starting one year after commercial operation begins, annual compliance statements will be submitted to the CDFandG and the CEC for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by the project owner and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Biological Resources	1-8	Complete - report only for 2020	Visual assessment monitoring studies shall be conducted by PG&E in the vicinity of Unit 16 to determine low-level chronic visual drift effect on the forested area and on nearby plant communities of the endangered plant species, Steptanthus morrisonii complex. These studies will include: • Baseline studies of qualitative observations of the Streptanthus morrisonii communities for visible damage due to drift. • Baseline studies of qualitative observations performed in the forested areas to determine potential effects on the study area from drift.	Project owner shall provide an initial report to the CDFandG and the CEC describing the locations of this monitoring in relation to the Unit 16 power plant and the methods to be used in conducting the study. This report shall be submitted prior to the start of construction. PG&E will also include the progress of these studies in the semi-annual compliance statements verifying compliance of biological protection measures associated with power plant construction. These statements will be submitted to the California Department of Fish and Game and the CEC starting six months after the start of construction and continuing until one year after the start of commercial operations. Starting one year after commercial operation begins, annual compliance statements will be submitted to the CDFandG and the CEC for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by project owner and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Biological Resources	1-10	Operations/ Ongoing	At the time the power plant is to be deactivated project owner will include in the decommissioning plan a biological resources element identifying mitigation and compensation measures.	Project owner will submit the biological resources element of the decommissioning plan to the CEC and CDFandG for a determination of adequacy and acceptability.	Ongoing	Unit 16 is still operational
COM	1	Operations/ Ongoing	Unrestricted Access The project owner shall ensure that the CPM, responsible staff, and delegate agencies are granted unrestricted access to the facility site, related facilities, project-related staff, and the records maintained on-site for the purpose of conducting facility audits, surveys, inspections, or general or closure-related site visits. Although the CPM will normally schedule site visits on dates and times agreeable to the project owner, the CPM reserves the right to make unannounced visits at any time, whether such visits are by the CPM in person or through representatives from staff, delegated agencies, or consultants.	N/A	Ongoing	GPC is in compliance.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
COM	2	Operations/ Ongoing	Compliance Record The project owner shall maintain electronic copies of all project files and submittals on-site, or at an alternative site approved by the CPM for the operational life and closure of the project. The files shall also contain at least: 1.the facility's Application for Certification, if available; 2.all amendment petitions, staff approvals and CEC orders; 3.all site-related environmental impact and survey documentation; 4.all appraisals, assessments, and studies for the project; 5.all finalized original and amended design plans and "as-built" drawings for the entire project; 6.all citations, warnings, violations, or corrective actions applicable to the project, and 7.the most current versions of any plans, manuals, and training documentation required by the conditions of certification or applicable LORS. Staff and delegate agencies shall, upon request to the project owner, be given unrestricted access to the files maintained pursuant to this condition.	N/A	Ongoing	GPC is in compliance.
COM	3	Operations/ Ongoing	Compliance Verification Submittals A cover letter or email from the project owner or an authorized agent is required for all compliance submittals and correspondence pertaining to compliance matters. The cover letter or email's subject line shall identify the project by the docket number for the compliance phase, cite the appropriate condition of certification number(s), and give a brief description of the subject of the submittal. When submitting supplementary or corrected information, the project owner shall reference the date of the previous submittal and the condition(s) of certification applicable. All reports and plans required by the project's conditions of certification shall be submitted in a searchable electronic format (.pdf, MS Word or Excel, etc.) and include standard formatting elements such as a table of contents identifying by title and page number each section, table, graphic, exhibit, or addendum. All report and/or plan graphics and maps shall be adequately scaled and shall include a key with descriptive labels, directional headings, a distance scale, and the most recent revision date. The project owner is responsible for the content and delivery of all verification submittals to the CPM and notification that the actions required by the verification were satisfied by the project owner or an agent of the project owner. All submittals shall be accompanied by an electronic copy on an electronic storage medium, or by e-mail, as agreed upon by the CPM. If hard copy submittals are required, they should be addressed as follows: Compliance Project Manager Geysers Energy Project (Docket Number) California Energy Commission 1516 Ninth Street (MS-2000)	N/A	Ongoing	GPC is in compliance
COM	4	Pre-con	Monthly Compliance Report During the construction of approved project modifications requiring construction of 6 months or more, the project owner or authorized agent shall submit an electronic searchable version of the MCR to the CPM within ten (10) business days after the end of each reporting month. No MCR shall be required for maintenance and repair activities, regardless of duration. MCRs shall be submitted each month until construction is complete, and the final certificate of occupancy is issued by the DCBO. MCRs shall be clearly identified for the month being reported. The MCR shall contain, at a minimum: 1.A summary of the current project construction status, a revised/updated schedule if there are significant delays, and an explanation of any significant changes to the schedule; 2.Construction submittals pending approval, including those under review, and comments issued, and those approved since last MCR; 3.A projection of project compliance activities (compliance submittals, etc.) scheduled during the next (2) two months; the project owner shall notify the CPM as soon as any changes are made to the project construction schedule that would affect compliance with conditions of certification; 4.A listing of incidents (safety, etc.), complaints, inspections (status and those requested), notices of violation, official warnings, trainings administered, and citations received during the month; a list of any incidents that occurred during the month, a description of the actions, taken to date to resolve the issues; and the status of any unresolved actions noted in the previous MCRs; 5.Documents required by specific conditions (if any) to be submitted along with each MCR. Each of these items shall be identified in the transmittal letter, as well as the conditions they satisfy, and submitted as attachments to the MCR; 6.A list of conditions (if any) that have been satisfied during the reporting period, and adscription or reference to the actions that satisfied the condition; and 7.A listing of the month's additions to the Compliance Record	N/A	Ongoing	GPC is in compliance. Monthly compliance reports are sent to the CEC.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
COM	5	Operations/ Ongoing	Periodic and Annual Compliance Reports The project owner shall continue to submit searchable electronic ACRs to the CPM, as well as other PCRs required by the various technical disciplines. ACRs shall be completed for each year of commercial operation and are due each year on a date agreed to by the CPM. Other PCRs (e.g. quarterly reports), may be specified by the CPM. The searchable electronic copies may be filed on an electronic storage medium or by e-mail, subject to CPM approval. Each ACR must include the AFC number, identify the reporting period, and contain the following: 1.an updated list showing the status of all conditions of certification (fully satisfied conditions do not need to be included in the matrix after they have been reported as completed); 2.a summary of the current project operating status and an explanation of any significant changes to facility operating status during the year; 3.documents required by specific conditions to be submitted along with the ACR; each of these items shall be identified in the transmittal letter with the conditions it satisfies, and submitted as an attachment to the ACR; 4.a cumulative list of all known post-certification changes approved by the CEC or the CPM; 5.an explanation for any submittal deadlines that were missed, accompanied by an estimate of when the information will be provided; 6.a listing of filings submitted to, or permits issued by, other governmental agencies during the year; 7.a projection of project compliance activities scheduled during the next year; 8.a listing of the year's additions to the Compliance Record; 9.an evaluation of the Site Contingency Plan, including amendments and plan updates; and 10.a listing of complaints, incidents, notices of violation, official warnings, and citations received during the year, a description of how the issues were resolved, and the status of any unresolved complaints.	N/A	Ongoing	The Compliance Plan has been updated for all applicable verification items for the applicable time frame in 2020.
COM	6	Operations/ Ongoing	Confidential Information Any information that the project owner designates as confidential shall be submitted to the CEC's Executive Director with an application for confidentiality, pursuant to Title 20, California Code of Regulations, section 2505(a).	N/A	Ongoing	GPC is in compliance.
COM	7	Operations/ Ongoing	Annual Energy Facility Compliance Fee Pursuant to the provisions of section 25806 (b) of the Public Resources Code, the project owner shall continue paying an annual compliance fee which is adjusted annually, due by July 1 of each year in which the facility retains its certification.	N/A	Ongoing	GPC is in compliance.
COM	8	Operations/ Ongoing	Amendments and Staff Approved Project Modifications The project owner shall petition the CEC, pursuant to Title 20, California Code of Regulations, section 1769, to modify the design, operation, or performance requirements of the project or linear facilities, or to transfer ownership or operational control of the facility. Section 1769 details the required contents for a Petition to Amend a CEC Decision. A project owner is required to submit a five thousand ($5,000) dollar fee for every Petition to Amend a previously certified facility, pursuant to Public Resources Code section 25806(e). If the actual amendment processing costs exceed $5,000.00, the total Petition to Amend reimbursement fees owed by a project owner will not exceed seven hundred fifty thousand dollars ($750,000), adjusted annually.	N/A	Ongoing	GPC is in compliance.
COM	9	Operations/ Ongoing	Incident-Reporting Requirements Within 24 hours of its occurrence, the project owner shall report to the CPM any safety-related incident. Such reporting shall include any incident that has resulted in death to a person; an injury or illness to a person requiring overnight hospitalization; a report to Cal/OSHA, OSHA, or other regulatory agency; or damage to the property of the project owner or another person of more than $50,000. If not initially provided, a written report also will be submitted to the CPM within five business days of the incident. The report will include copies of any reports concerning the incident that have been submitted to other governmental agencies.	N/A	Ongoing	GPC is in compliance.
COM	10	Operations/ Ongoing	Non-Operation and Restoration Plans If the facility ceases operation temporarily because it is physically unable to operate (excluding maintenance or repair) for longer than three (3) months (or other CPM-approved date), the project owner shall notify the CPM. Notice of planned non-operation, excluding maintenance or repair, shall be given at least two (2) weeks prior to the scheduled date. Notice of unplanned non-operation shall be provided no later than one (1) week after non-operation begins.	N/A	Ongoing	GPC is in compliance.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
COM	11	Operations/ Closure	Facility Closure Planning The project owner shall coordinate with the CEC to plan and prepare for eventual permanent closure and license termination by filing a Facility Closure Plan. The Facility Closure Plan shall be filed 90 days before the commencement of closure activities or at such other time agreed to between the CPM and the project owner. The Facility Closure Plan shall include the information set forth in Title 20, California Code of Regulations, section 1769, but shall not be subject to the fee set forth in Public Resources Code section 25806(e).	N/A	Ongoing	GPC is in compliance.
FIRE PROTECTION	1	Operations/ Ongoing	The project owner shall notify and submit design drawings to the compliance project manager (CPM) for any planned modifications that would materially change the design, operation, or performance of the fire protection or fire alarm systems.	At least 15 business days before the start of any construction that materially changes the design, operation or performance made to the fire protection or fire alarm systems, the project owner shall submit a complete set of design drawings to the CPM for review and approval, and to the DCBO for plan check against the applicable LORS and construction inspection.	Ongoing	There were no modifications made during this reporting period.
FIRE PROTECTION	2	Operations/ Ongoing	The project owner shall maintain and update, as appropriate, the fire protection Basis of Design documents and appendices to ensure that the fire protection and fire alarm systems are documented and accurately depicted on drawings for the project site.	The project owner shall provide the CPM with an updated Basis of Design document within 30 days of completing any changes to fire protection or fire alarm systems that result in changes to the Basis of Design.	Ongoing	Once Basis of Design is completed and approved by CEC, an inspection program will be implemented.
FIRE PROTECTION	3	Operations/ Ongoing	The project owner shall ensure that all required inspections, testing, and maintenance (ITM) are performed on the project's fire protection systems as specified and in the frequencies set forth in Title 19, California Code of Regulations, section 904(a) and on the project's fire alarm systems as specified in the applicable edition of the National Fire Protection Association (NFPA) 72 National Fire Alarm and Signaling Code.	The project owner shall provide to the CPM copies of the completed ITM reports for the project's fire protection systems and fire alarm systems within 15 days of receiving the ITM reports. The ITM reports shall be submitted quarterly for the first two years following approval of this condition, then all ITM reports shall be submitted annually thereafter.	Ongoing	ITMs were completed and reported per December 2020 Recommissioning report dated 1/8/21, TN#240530. ITM reports are submitted under confidential designation and are not attached to the ACR at this time.
FIRE PROTECTION	4	Operations/ Ongoing	Whenever deficiencies or failures are identified in any of the ITM reports for the project's fire protection or fire alarm systems, the project owner shall provide the CPM with a summary of the following information from the ITM reports required by FIRE SAFETY-3: (a)A summary of all deficiencies or failures identified; (b)The corrective action the project owner has taken, or plans to take, to address each identified deficiency or failure; and (c)The completion date or an estimated completion date to implement the corrective action.	The project owner shall provide the CPM with the information from (a)-(c) within 15 days of receiving the ITM reports.	Ongoing	GPC is in compliance
FIRE PROTECTION	5	Operations/ Ongoing	In the case of a fire protection system impairment, as defined in the latest applicable edition of NFPA-25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, California Edition, that would prevent the proper functioning of any portion of the fire protection or fire alarms systems during a fire event, the project owner shall inform the CPM of the impairment along with the following information: (a)The date discovered; (b)The location of the impairment; (c)A short description, including a photograph (if applicable), of the impairment and its cause (if known), and a description of the actions to be taken to protect life and safety until the impairment is corrected; (d)The corrective action outlining how the impairment was repaired, including any engineering drawings or inspections, not already provided to the CPM or the DCBO; (e)The date the impairment was repaired; and (f)Before and after photographs (if applicable) showing the completed impairment repair.	The project owner shall provide the CPM with information from (a)-(c) within two business days of the discovery of an impairment, or within a time as approved by the CPM. The project owner shall provide the CPM with information from (d)-(f) within 5 days of correction of the impairment.	Ongoing	No impairments were discovered during the reporting period.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
GEN	1	Operations/ Ongoing	Whenever material modifications to the facility are planned, the project owner shall design, construct, and inspect project modifications in accordance with the applicable version of the California Building Standards Code (CBSC), also known as Title 24, California Code of Regulations, which encompasses the California Building Code (CBC), California Administrative Code, California Electrical Code, California Mechanical Code, California Plumbing Code, California Energy Code, California Fire Code, California Code for Building Conservation, California Reference Standards Code, and all other applicable engineering laws, ordinances, regulations and standards (LORS) in effect at the time initial design plans are submitted to the chief building official (CBO) for review and approval (the CBSC in effect is the edition that has been adopted by the California Building Standards Commission and published at least 180 days previously). The project owner shall ensure that the provisions of the above applicable codes are enforced during the construction, addition, alteration, or demolition of the modifications. Where, in any specific case, different applicable sections of the code specify different materials, methods of construction or other requirements, the most restrictive shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall govern. The project owner shall ensure that all contracts with contractors, subcontractors, and suppliers clearly specify that all work performed, and materials supplied comply with the codes listed above.	Within 30 days following receipt of the certificate of occupancy (if one is required by the CBO) for any material project modification completed after the effective date of this condition, the project owner shall submit to the compliance project manager (CPM) a statement of verification, signed by the responsible design engineer, attesting that all designs, construction, installation, and inspection requirements of the applicable LORS and the CEC's decision have been met in the area of facility design. The project owner shall also provide the CPM a copy of the certificate of occupancy within 30 days of receipt from the CBO. Once the certificate of occupancy has been issued, the project owner shall inform the CPM at least 30 days prior to any construction, addition, alteration, or demolition to be performed on any portion(s) of the completed facility that requires CBO approval for compliance with the above codes. The CPM will then determine if the CBO needs to approve the work.	Ongoing	On December 17, 2018, the CEC approved the installation of a stationary permanent emergency diesel-driven engine for the cooling tower wet-down system to aid in fire prevention, per order #18-1210-2. Documents were submitted by the DCBO to the CEC.
Geotechnical/Structural Engineering	15-15	Operations/ Ongoing	The as-graded and as-build plans shall be maintained as permanent records	Project owner shall identify the person or office to contact for CEC examination of such records.	Ongoing	All As-Built plans are available in the Compliance Record.
Geotechnical/Structural Engineering	15-16	Operations/ Ongoing	If notified by either a responsible CB0 or by CEC that any proposed design plans or specifications or any substantial revisions thereof are not acceptable, project owner shall not proceed with any construction based on such plans and specifications.	Upon notification that the original design plans are unacceptable, project owner shall prepare and submit revised design plans to the responsible CB0 or CEC. In its periodic compliance reports to the CEC, project owner shall indicate any dates of construction shutdown resulting from the no acceptance of original design plans and specifications.	Ongoing	GPC did not receive notification that any design plans are unacceptable during the reporting period.
Noise	5-3	Operations/ Ongoing	Within 90 days after the plant reaches its rated power generation capacity and construction is complete, PG&E shall conduct a noise survey at the nearest sensitive receptor and at 500 feet from the generating station. The survey will cover a 2a-hour period with results reported in terms of Lx (x=10, 50, and 90), Leq and Ldn levels. PG&E shall prepare a report of the survey that will be used to determine the plant's conformance with county standards. In the event that county standards are being exceeded, the report shall also contain a mitigation plan and a schedule to correct the noncompliance. No future noise surveys of off-site operational noise are required unless the public registers complaints or the noise from the project is suspected of increasing due to a change in the operation of the facility.	Within 30 days of the noise survey, project owner shall submit its report to the Lake County Air Pollution Control District.	Ongoing	No complaints were received during the reporting period.
Noise	5-4	Operations/ Ongoing	Within 180 days after the start of commercial operation, project owner shall prepare a noise survey report for the noise-hazardous areas in the facility. The survey shall be conducted by an acoustician in accordance with the provisions of 8 CAC, Article 105. The survey results will be used to determine the magnitude of employee noise exposure. If employee complaints of excessive noise arise during the life of the project, Cal/DOSH, Department of Industrial Relations, shall make a compliance determination.	project owner shall notify Cal/DOSH and the CEC of the availability of the report.	Ongoing	No complaints were received during the reporting period.

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
Public Health	6-1	Operations/ Ongoing	Project Owner shall quarterly sample and analyze radon-222 concentrations in noncondensable gases entering the power plant in incoming steam line, vent off-gas line, or H2S abatement off-gas line. This sampling program will comply with the most recent California Department of Health Services, Radiologic Health Service (CDHS/RHS) requirements for radon-222 monitoring and reporting. In addition, this radon-222 steam monitoring program will be conducted quarterly for a period of two (2) years after the scheduled date of commercial operation and annually thereafter. If monitoring results indicate that the radon-222 release from Unit 16 is well within applicable standards, the monitoring program may be modified, reduced in scope, or eliminated provided project owner obtains the permission of CDHS/RHS. As new information and techniques become available, with concurrence of project owner and CDHS/RHS, changes may be made to the program or the methods employed in monitoring radon-222.	During the first year of commercial operation, project owner shall provide CDHS/RHS with the results of the quarterly sampling within 30 days of the end of the quarter. After the first year of commercial operation, project owner shall provide CDHS/RHS with an annual report summarizing quarterly sampling results. The annual report will comply in format and content with the most recent CDHS/RHS reporting requirements.	Ongoing	See attachment Public Health 6-1 for table of quarterly analysis.
Public Health	6-2	Operations/ Ongoing	If the radon-222 concentration exceeds 3.0 picocuries per liter (pCi/1) in the cooling tower exhaust, project owner must inform the CDHS/RHS with a special report.	project owner shall provide a written report to CDHS/RHS of sample results within 30 days of confirming an exceedance of 3.0 pCi/1 radon-222 in the cooling tower exhaust.	Ongoing	See the attached table referenced in Public Health 6-1. There was no exceedance of 3.0 pCi/l during the reporting period.
Public Health	6-3	Operations/ Ongoing	If the radon-222 concentrations exceed 6.0 pCi/1 in the cooling tower exhaust, project owner shall notify the CDHS/RHS and the CEC by telegram or telephone upon confirmation of the sample result. Confirmation includes reanalyzing the sample by project owner or another qualified laboratory. The confirmation procedures used shall be the same as the routine analysis, but may include sending samples to CDHS/RHS or other qualified laboratories for analysis. Sample result confirmation must be accomplished in the quickest manner possible and should take less than five calendar days.	Project Owner shall notify CDHS/PHS and the CEC within 24 hours of confirming the sample results. Project Owner shall provide a special report to CDHS/PHS and the CEC outlining corrective actions taken.	Ongoing	See the attached table referenced in Public Health 6-1. There was no exceedance of 6.0 pCi/l during the reporting period.
Safety	9-2	Operations/ Ongoing	On-site worker safety inspections shall be conducted by the California Division of Occupational Safety and Health (Cal/DOSH) during construction and operation of the facility or when an employee complaint has been received. Cal/DOSH shall notify the CEC in writing in the event of a violation that could involve DOSH action affecting the construction or operation schedule.	Project owner shall note any Cal/DOSH inspections in its periodic compliance reports	Ongoing	GPC is in compliance. No Cal/OSHA inspections were performed during the reporting period
Soils	8-3	Operations/ Ongoing	PG&E shall annually measure the amount of sediment accumulated in the sedimentation basins. This information will be used to evaluate the success of the erosion control plan. The accumulated sediment will be estimated by adequate measuring techniques (e.g., staff gauge). Sediment quantities will be verified when sediment is removed. The sediment basins should not be fuller than 60 percent of actual capacity prior to each winter season. The basins will be cleaned as necessary.	The initial measurement shall be taken one year after the start of site preparation, and subsequent measurements shall be taken at one-year intervals thereafter. PG&E shall submit an annual written report to the Central Valley Regional Water Quality Control Board and the CEC beginning one year after the start of commercial operation and continuing for a period of three years, at which time, monitoring and reporting may be continued for a period agreed to by PG&E and the CEC staff, or in the absence of such agreement and upon submission to the Commission itself, for a period as directed by the Commission. Included in each annual report will be a summary of required maintenance and repairs to the erosion control/sediment containment system.	Ongoing	See attached list of recommended maintenance tasks
Solid Waste Management	10-1	Operations/ Ongoing	10-1PG&E shall ensure that any hazardous waste hauler employed has a certificate of registration from the California Department of Health Services, Hazardous Materials Management Section.	PG&E shall keep a letter on file verifying that hazardous waste haulers have DOHS certificates of registration.	Ongoing	All waste haulers are in compliance and on file in the DTSC database.
Solid Waste Management	10-2	Operations/ Ongoing	The Stretford process wastes include elemental sulfur and the Stretford purge stream. PG&E shall ensure that elemental sulfur is stored in a steam coil heated tank and removed periodically to be sold or to be disposed at a site approved for such wastes. PG&E shall ensure that the Stretford purge stream is either pumped into the overflow structure of the cooling tower basin for reinjection into the steam reservoir or trucked to an approved disposal site. Any sludge which accumulates in the cooling tower will be vacuumed off and hauled by a registered hazardous waste hauler to an approved disposal site.	PG&E shall submit final design plans and "As Built" drawings to the Lake County CBO incorporating these design features. In addition, PG&E shall each month submit completed hazardous waste manifests to DOHS in compliance with Section 66475 of Title 22, CAC.	Ongoing	Any excess Stretford solution is sent to the cooling tower for continued use of a abatement chemical.
Solid Waste Management	10-3	Operations/ Ongoing	Project owner shall ensure that hazardous wastes are taken to a facility permitted by DOHS to accept such wastes. (PG&E has indicated its intention to dispose of wastes generated by Geysers Unit 16 at either the Middletown or Kelseyville approved sites.)	PG&E shall notify the CEC, DOHS, and Solid Waste Management Board of the selected disposal site. Any notice of change in disposal sites will be submitted as changes occur.	Ongoing	GPC is in compliance. No update to changes in approved disposal sites

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
Solid Waste Management	10-5	Operations/ Ongoing	If hazardous wastes, including Stretford sulfur effluent, are stored on site for more than 60 days, PG&E shall obtain a determination from the DOHS that the requirements of a Hazardous Waste Facility Permit have been satisfied.	PG&E shall notify the CEC if it files an in-lieu application with DOHS for the operation of a Hazardous Waste Facility.	As needed	GPC abides by DTSC Guidance for GPC's generator status.
Transmission Line Safety and Nuisance	13-4	Operations/ Ongoing	In the event of complaints regarding induced currents from vehicles, portable objects, large metallic roofs, fences, gutters, or other objects, project owner shall investigate and take all reasonable measures at its own expense to correct the problem for valid complaints, provided that (a) the object is located outside the right- "of-way, or (b) the object is within the right-of-way and existed prior to right-of-way acquisition. For objects constructed, installed, or otherwise placed within the right-of-way after right-of-way acquisition, project owner shall notify the owner of the object that it should be grounded. In this case, grounding is the responsibility of the property owner. project owner shall advise the property owner of this responsibility in writing prior to signing the right-of-way agreement.	Project owner shall maintain a record of activities related to this paragraph. These records shall be made available to CEC staff upon request.	Ongoing	No complaints received concerning induced currents from the GPC plants during the reporting period.
Transmission Line Safety and Nuisance	16-2	Operations/ Ongoing	PG&E shall maintain the vegetation clearance for conductors and structures on the transmission lines in accordance with Title 14, California Administrative Code, Sections 1250 - 1258 and Public Resources Code, Sections 4292 - 4296.	Within 120 days after completion of construction, PG&E shall submit a statement to the California Department of Forestry and the CEC that the transmission line has been constructed in accordance with applicable requirements. PG&E shall also inspect the transmission line annually to ensure that the line maintains required clearances during the fire season. In the event that noncompliance is determined by the CDF, the CDF shall require PG&E to take measures necessary to correct the noncompliance. If PG&E's corrective measures are unsatisfactory in the opinion of the CDF, the CDF shall inform the CEC and shall recommend a course of action.	Ongoing	GPC is in compliance with GPC's Transmission Line maintenance program
Transmission Line Safety and Nuisance	16-6	Operations/ Ongoing	On-site worker safety inspections shall be conducted by the California Division of Occupational Safety and Health (Cal/DOSH) during construction and operation of the transmission line or when an employee complaint has been received. Cal/DOSH shall notify the CEC in writing in the event of a violation that could involve DOSH actions affecting the transmission line construction or operation schedule.	PG&E shall note any Cal/DOSH inspections in its periodic compliance reports.	Ongoing	No injuries have been reported during the reporting period
Water Quality/ Hydrology/ Water Resources	11-2	Operations/ Ongoing	Project owner shall comply with the "Emergency Accidental Spill and Discharge Control Plan and Procedures, Geysers Power Plant" (revised February 15, 1980).	Verification procedures are identified in the document.	Ongoing	GPC is in compliance with the Spill Prevention, Response, Monitoring, Contingency and Cleanup Plan for Central Valley RWQCB WDR's R5-2002-0010 and 99-042

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
Water Quality/ Hydrology/ Water Resources	11-6	Complete - report only for 2020	To prevent spills of condensate and other materials from leaving the site, PG&E shall construct an impermeable concrete or asphaltic concrete retention barrier around the plant. PG&E shall also pave the site, except the switchyard, with two inches of asphaltic concrete and attain a permeability of at least 1 x 10-6 cm/sec. As a result of this construction, the paved area of the plant site will serve as a spill retention basin. The proposed retention basin is designed to retain the maximum condensate spill expected to occur before plant personnel can correct the cause of the spill. In addition, the design will accommodate the runoff from a 30-minute 100-year storm. Should a spill of condensate or other materials occur, the spill would flow to a 1,000 gallon, concrete-lined catch basin located at the lowest point on the plant site. The catch basin shall be equipped with a 100 gallon per minute pump to return spilled material to the cooling tower basin for reinjection. If a spill occurs which is larger than the capacity of the pump, PG&E plant personnel shall use a portable pump to remove excess material. Alarm systems will notify plant operators when a spill has occurred and when the catch basin pump has started. PG&E plant personnel shall respond to the alarms within 30 minutes and take measures necessary to correct the problem.	PG&E shall submit final design plans and "As Built" drawings to the Lake County CBO incorporating this design requirement and verification of the 1 x 10-6 cm/sec permeability of the pad layer. In addition, the Plant Superintendent shall file a statement with the CVRWQCB and the CEC at the start of the operations verifying that plant personnel are trained and prepared to handle spills.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Water Quality/ Hydrology/ Water Resources	11-7	Complete - report only for 2020	Project owner shall ensure that rainwater entering the Stretford process area will not enter surface water or groundwater. The rainwater shall be used in the Stretford process or pumped to the cooling tower overflow structure. The steam condensate from the plant shall be used for cooling water, with any excess reinjected into the geothermal reservoir.	Project Owner shall submit final design plans and "As-Built" drawings to the Lake County CB0 incorporating this rainwater collection and routing design requirement.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Water Quality/ Hydrology/ Water Resources	11-8	Complete - report only for 2020	To minimize the potential adverse impacts of storm runoff on the quality of Bear Canyon and Anderson Creek below the confluence with Bear Canyon Creek, PG&E shall return plant site runoff resulting from the first significant storm to the cooling tower basin for subsequent injection into the geothermal reservoir. Other storm runoff will be disposed in the same manner. When the capacity of the return system is exceeded and a spill has not occurred, runoff may, if necessary, be released from the site through a manually controlled valve. Under such conditions, the impacts on water quality should be minimal due to material dilution from heavy rainfall. If storm runoff is released from the power plant site, project owner shall satisfy the Basin (5A) Plan intent and any applicable requirements of the CVRWQCB.	PG&E shall submit final design plans and "As-Built" drawings to the Lake County CB0 incorporating this design requirement. In addition, PG&E shall notify the CEC when the CVRWQCB has approved PG&E's plan.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Water Quality/ Hydrology/ Water Resources	11-9	Complete - report only for 2020	Project owner shall dispose of domestic wastewater by injection into the steam supplier's reinjection system. The waste will be treated in a septic tank to remove solids, and discharged to the reinjection line at a point between the condensate surge pond and the reinjection well.	Project Owner shall obtain an in-lieu sanitation permit in accordance with Lake County ordinance and shall provide final design plans and "As-Built" drawings to the Lake County CB0 incorporating this design requirement for the domestic waste disposal system.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.
Water Quality/ Hydrology/ Water Resources	11-10	Operations/ Ongoing	Project owner will utilize condensed steam for cooling water purposes, acquire an outside source for freshwater supplies, and utilize annually an estimated 3.6 million gallons (12 acre feet) of water for construction.	PG&E will submit to the CEC documentation showing: a.The source and amount of cooling tower basin start-up water, and b.The source, means (appropriation, purchase), and amount of fresh water supply. Under certain conditions, PG&E or its contractor may need to acquire permits or waivers. This information shall be submitted prior to the commencement of power plant or transmission line switchyard construction. The project owner shall provide the Compliance Project Manager with copies of all local and state water quality permits related to the use and disposal of reclaimed municipal wastewater within thirty (30) days of receipt. In the annual compliance reports. the project owner shall provide the CPM with data on the annual quantity of water reinjected at the facility, and a copy of the report submitted to the California Department of Health Services on the additional uses of recycled water per Provision #2 of the December 5. 2003 California Department of Health Services approval letter.	Ongoing	Recycled water was not utilized at this facility during the reporting period

Technical Area	No.	Facility Status	Condition of Certification	Compliance Verification	Status	2020 Annual Compliance Report
Worker Safety	1	Complete - report only for 2020	Project owner will utilize condensed steam for cooling water purposes, acquire an outside source for freshwater supplies, and utilize annually an estimated 3.6 million gallons (12 acre feet) of water for construction.	The project owner shall complete the physical disconnection of the cooling tower wet-down system from the plant's fire protection system no later than June 1, 2019, or a later date agreed upon by the CPM, unless the CPM has approved a commissioned, integrated system. Within 10 days after the disconnection, the project owner shall submit a letter stating that the physical disconnection has occurred and provide a photograph showing the disconnection. The CPM shall be notified at least 30 days prior to the current disconnection date if the project owner wishes to seek an extension to the current disconnection date.	Complete	Condition is complete and will no longer be provided to the CEC in the ACR.

CONDITION OF CERTIFICATION
BIOLOGICAL RESOURCES 1-3

Attachment BR 1-3a: Aquatic Monitoring Report

Geysers Quicksilver Plant (Unit 16) 79-AFC-05
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

BEAR CANYON AND WEST FORD FLAT AQUATIC MONITORING PROGRAM

Annual Report 2020 (BC/WFF XXXIII)

Prepared for:
Calpine Corporation

January 2021

BEAR CANYON AND WEST FORD FLAT AQUATIC MONITORING PROGRAM

Annual Report 2020 (BC/WFF XXXIII)

Prepared for:
Calpine Corporation

January 2021

1425 N. McDowell Boulevard
Suite 200
Petaluma, CA 94954
707.795.0900
www.esassoc.com

Los Angeles

Oakland

Portland

Sacramento

San Diego

San Francisco

Seattle

Tampa

Woodland Hills

TABLE OF CONTENTS

Bear Canyon and West Ford Flat Aquatic Monitoring Program - Annual Report 2020 (BC/WFF XXXIII)

List of Figures

List of Tables

I. INTRODUCTION

The Bear Canyon/West Ford Flat (BC/WFF) aquatic monitoring program was initiated in 1988 and is sponsored by Calpine Corporation. The program monitors streams in and around the Bear Canyon and West Ford Flat power plants and steam fields, which are operated by Calpine Corporation, and is required by Lake County Use Permits for the Bear Canyon and West Ford Flat power plants; and by the Central Valley Regional Water Quality Control Board's (RWQCB) Waste Discharge Order No. 99-42 for the Unit 13 and Unit 16 Power Plants and Waste Discharge Order No. 99-043 for the West Ford Flat and Bear Canyon Power Plants. Copies of the report are forwarded to Lake County and the RWQCB. In 1998, monitoring responsibility transferred from the Institute of Chemical Biology (ICB) to Environmental Science Associates (ESA), who presently conducts the program. A complete history of the program and changes made since 1990 is provided in the BC/WFF XXV, 2012-2013 annual report (ESA, 2013).

A further change was implemented with the 2015-2016 report (ESA, 2017). In the past, the annual BC/WFF monitoring period extended from July of one year through April of the following year. As such, the data collections did not occur within a given calendar year or even within the same water year. At the recommendation of ESA, Calpine elected to change the schedule of reporting such that future annual summary reports would present the results of sample collections conducted within the same calendar year (i.e., April, July, and October of the same year). The actual sampling frequency or timing are not being changed; only the monitoring period summarized in the annual reports. To effect this change, the 2015-2016 report (ESA, 2017) summarized the results of BC/WFF monitoring activities conducted during two calendar years, 2015 and 2016. This current report summarizes the monitoring results for the 2020 calendar year.

The 2020 (BC/WFF XXXIII) monitoring period examined water quality and fish populations between April and October 2020 at six monitoring stations located both upstream and downstream of Calpine facilities. Benthic macroinvertebrates (BMI) are sampled every three years, and macroinvertebrate data were last reported for July 2019 (ESA, 2020); hence, BMI samples will again be collected and analyzed in July 2022.

Since its inception, the BC/WFF program has collected water quality data at six primary monitoring stations: An-2.8, An-4.4, BeC-0.5, CuC-0.1, Gu-0.6, and Gu-2.4 within the Anderson Creek watershed in Lake County (Figure I.1). The locations of the fish and benthic macroinvertebrate survey sites are in some cases slightly offset from the primary water quality sampling stations due to more appropriate habitat conditions (see Table I.1). As a result of recently changed conditions at fish sampling station Gu-1.9 related to the 2015 Valley Fire, particularly the high number of felled Douglas fir trees within the creek bed, this site has become inaccessible for sampling and has been discontinued. Starting in July 2019, fish and macroinvertebrate sampling has been moved upstream from Gu-1.9 to the primary water quality sampling site Gu-2.4. Moreover, significant geomorphic changes (scour and aggradation)

occurred at fish and macroinvertebrate sampling site BeC-0.9 during the 2018-2019 winter season. While BeC-0.9 remains accessible for sampling, fish habitat quality and quantity has been significantly altered to the extent of rendering any comparisons to past fish population estimates at this site irrelevant and potentially misleading. A new fish and macroinvertebrate sampling site (BeC-0.6; Figure I.1) was established approximately 650 ft downstream of the discontinued site in July 2019.

Water quality parameters examined included water temperature, specific conductance, dissolved oxygen, stream flow, and turbidity. Furthermore, samples were collected at all stations and analyzed at a U.S. Environmental Protection Agency (USEPA) certified analytical laboratory. Fish population monitoring was conducted at all stations in July using a standard electrofishing protocol.

TABLE I.1

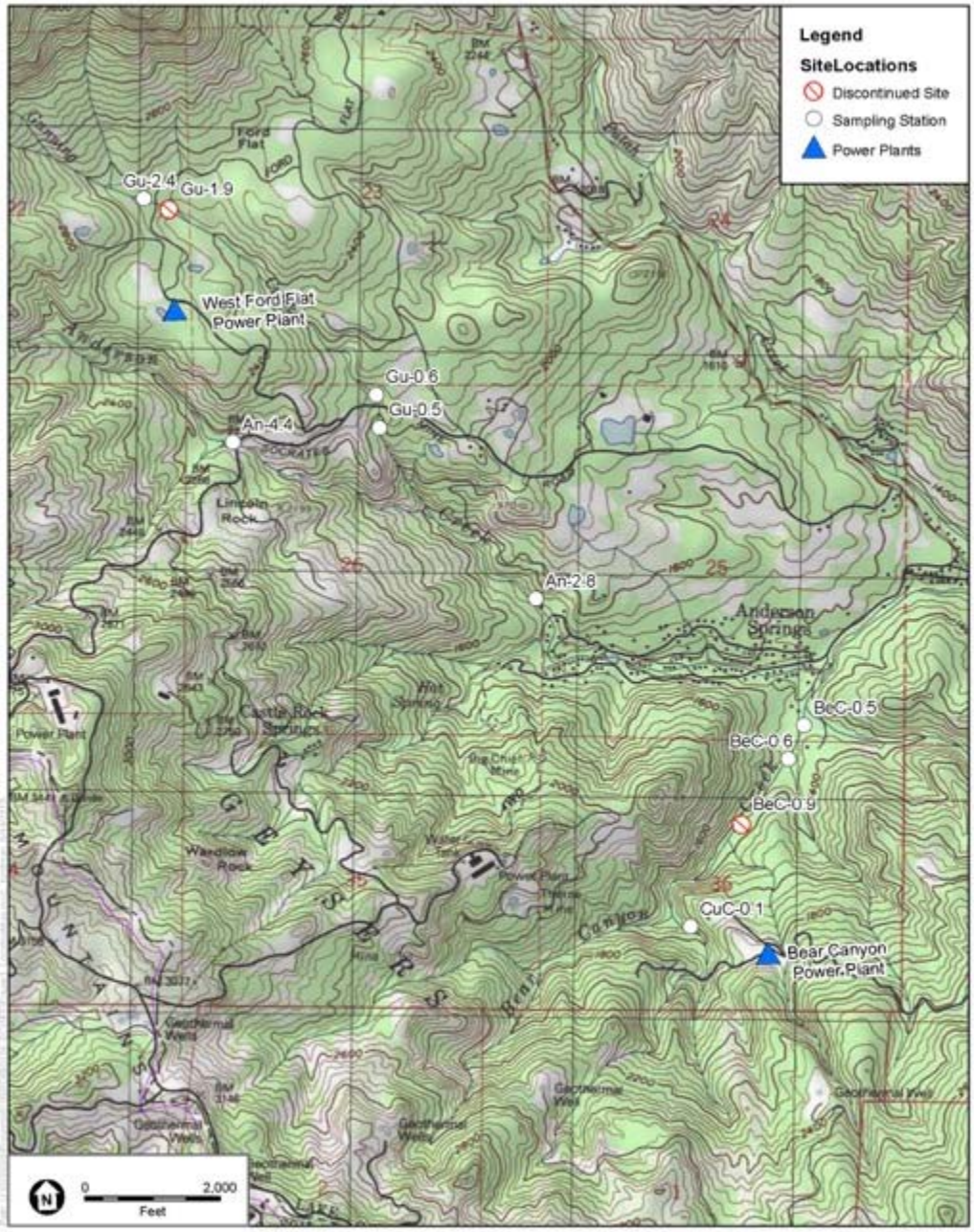
BC/WFF MONITORING STATIONS AND TASKS FOR 2020

Task	An-2.8	An-4.4	Gu-0.5	Gu-0.6	Gu-1.9	Gu-2.4	BeC-0.5	BeC-0.6	BeC-0.9	CuC-0.1
H2O	X	X		X		X	X			X
FISH	X	X	X			X		X		X
BMI										

NOTE: H2O = Water quality, FISH = Fish populations, BMI = Benthic macroinvertebrate populations.

This current report presents and discusses the results of the 2020 BC/WFF monitoring period (i.e., April 2020 through October 2020). Data collected during the previous thirty-one years of BC/WFF monitoring and the preceding Known Geothermal Resources Area – Aquatic Resources Monitoring (KGRA-ARM) study (Karfiol and McMillan, 1983) are also summarized or referenced where appropriate.

On September 12, 2015, the Valley Fire began near Middletown, California, and ultimately burned over 75,000 acres in Lake, Sonoma, and Napa counties. Major areas impacted include Middletown, Hidden Valley, Anderson Springs, and Cobb. The Valley Fire significantly affected Calpine Corporation's BC/WFF operations and infrastructure, and extended to all six BC/WFF monitoring program sampling sites. Calpine's West Ford Flat Power plant has been out of operation since the fire.



SOURCE: ESA; USGS

Bear Canyon / West Ford Flat Aquatic Monitoring Program . 980174

Figure I-1
Approximate Locations of Sampling Stations, Discontinued Sites, and Power Plants

II. WATER QUALITY

II.1 Methods

The water quality analyses were conducted according to methodologies described in the KGRA-ARM Program (Karfiol and McMillan, 1983; McMillan, 1985), the Squaw Creek Aquatic Monitoring Program (SCAMP) studies (Jordan *et al.*, 1986, 1987, 1988), and the *Standard Methods for the Examination of Water and Wastewater* (APHA, 1995). The following parameters were measured in the field: temperature, specific conductance, dissolved oxygen, stream flow and hydrogen ion concentration (pH). Furthermore, water samples were collected in the field, preserved if appropriate, and sent to a USEPA-certified analytical laboratory for analysis of the following parameters: total suspended solids, total dissolved solids, turbidity, oil and grease, alkalinity, bicarbonate, carbonate, calcium, magnesium, ammonia, nitrate, sulfate, chloride, total and fecal coliform, aluminum, arsenic, boron, barium, cadmium, chromium, copper, iron, mercury, lead, selenium, vanadium, and zinc. Hardness of the water samples was determined through calculation.

In October 2002, Calpine Corporation staff assumed responsibilities for water quality field measurements and sample collections. During the 2020 monitoring period, Calpine submitted water quality samples to Alpha Analytical Laboratories, Inc., in Ukiah. BC/WFF water quality sample collections for the BC/WFF program were conducted in April, July, and October of 2020. Tables II.1 through II.3 list the values obtained for the tested parameters during the 2020 monitoring year. It should be noted that Alpha Analytical Laboratories, Inc. has periodically adjusted the reporting limits used for some of the analyses (e.g., aluminum). Reporting limits are the lowest concentration of a given parameter at which the applicable analytical methodology can detect the presence of that constituent (i.e., detection limit). For example, the reporting limit of 0.50 mg/l for chloride indicates that chloride concentrations less than 0.50 mg/l cannot be detected and are reported as “none detected (ND)” by the laboratory. Reporting limits (RL) for each constituent are provided in Tables II.1 through II.3 and should not be confused with regulatory water quality criteria or limits (e.g., acute criterion for chloride is 860 mg/l).

II.2 Results

II.2.1 Physical and Aggregate Properties

Water Temperature

Water temperatures were measured in the field using an Aquacheck Model A51600. Temperature was recorded to the nearest 0.1°C.

Water temperatures naturally fluctuate according to the season and the time of day. High temperatures are critical to aquatic life and reduce the solubility of oxygen, accelerate the

metabolism of aquatic organisms, increase the toxicity of heavy metals and alter the species composition within the community (McKee and Wolf, 1963). Rainbow trout (*Oncorhynchus mykiss*) are generally tolerant of a maximum temperature of 24°C according to the USEPA (USEPA, 1986). The preferred temperature range for rainbow/steelhead trout is usually 15 to 18°C, but juveniles regularly persist in water where daytime temperatures reach 26 to 27°C (Moyle, 2002). For example, Kubicek and Price (1976) reported trout at the Geysers to have a maximum temperature tolerance of 26.5°C. However, long-term exposure to temperatures continuously above 24°C is usually lethal (Moyle, 2002).

During the BC/WFF 2020 sampling period, the highest water temperature (15.2°C) was recorded in April 2020 at An-2.8, at midday. The lowest recorded water temperature was 11.1°C at An-4.4 and in October 2020 during mid-morning sampling. As such, measured water temperatures did not exceeded the upper end of the preference range of rainbow trout during 2020 BC/WFF sampling.

Specific Conductivity

Specific (temperature compensated) conductivity was measured to the nearest 1 µmhos/cm using an Aquacheck Model A51600.

Specific conductivity is a measure of the capacity of water to conduct an electric current and is a quick method of measuring ion concentration and indicating total dissolved matter and alkalinity. All substances in solution collectively exert osmotic pressure on aquatic organisms. When the osmotic pressure is sufficiently high, water drawn over respiratory membranes and other delicate external organs can cause considerable cell damage. High concentrations of many kinds of pollutants present this danger in addition to any other toxic or corrosive effects they may exhibit (Eckblad, 1978). Streams with mixed fish populations usually have a specific conductance between 150 and 500 µmhos/cm (McKee and Wolf, 1963).

During the BC/WFF 2020 sample period, the lowest conductivity value was 77 µmhos/cm at Gu-2.4 in October 2020. The highest recorded value of 330 µmhos/cm was measured at CuC-0.1 in July 2020. High conductivity values are common in Bear Canyon Creek and Cub Canyon Creek.

Dissolved Oxygen

Dissolved oxygen was measured in the field using an Aquacheck Model A51600. Values were recorded to the nearest 0.1 mg/l.

Dissolved oxygen concentrations vary considerably with water depth, temperature, time of day, flow rate and other natural factors (Eckblad, 1978). Aquatic organisms require dissolved oxygen, and many fish species are limited to a specific concentration range. As discussed by Karfiol and McMillan (1983), and based on the requirements of the fish community, the Central Valley RWQCB (1998) recognized a lower limit of 7.0 mg/l for streams in the Geysers area. Although the USEPA (1986) states 4.0 mg/l as adequate, such a limited amount of dissolved oxygen would have a deleterious effect on salmonids in this area.

The lowest dissolved oxygen concentration of 7.7 mg/l was measured at BeC-0.5 in July 2020. Thus, dissolved oxygen levels remained within the tolerance range of rainbow trout at all sites during the 2020 sampling events.

Stream Flow

Stream flows were calculated by applying standard cross-sectional area methods (e.g., Platts *et al.*, 1983) using a Marsh-McBirney FLO-MATE Model 2000. Flows are reported to the nearest 0.01 cubic feet per second (cfs).

Water flow in the creeks of the Anderson Creek watershed is largely dependent on rainfall and runoff; there is no snowpack. The higher flows that accompany winter rains flush sediments and debris from the watercourses. Excessive flows can dislocate benthic macroinvertebrates and fish eggs. The rather low summer flows marginally maintain aquatic life in many sections of the watercourses. Reduced summer flows, accompanied by low dissolved oxygen levels and warm water temperatures, can significantly stress fish and other aquatic organisms.

During the 2020 sampling period, the lowest stream flow (0.10 cfs) was measured at CuC-0.1 in October. The highest flow of 4.81 cfs was recorded at An-2.8 in April. Measured streamflow rates in 2020 were noticeably lower at all sites and during all sampling events compared to 2019.

Total Suspended Solids (TSS)

Total suspended solids were measured in mg/l, using standard filtration, drying and weighing methods (APHA, 1995). The reporting limit for TSS is 1.0 mg/l (Tables II.1 through II.3).

The amount of suspended solids is one measure of watershed erosion. In addition to erosional silt, phytoplankton, zooplankton and organic detritus are typical components of suspended solids found in natural waters (McMillan, 1985). High concentrations of suspended solids can kill adult fish, smother eggs and fry, reduce primary productivity and alter temperature regimes. Over a period of time, amounts of inert solids in excess of 90 mg/l can be lethal to individual fish, and 270 mg/l may kill 50 percent of some fish populations when exposure is extended for 2 to 12 weeks (McKee and Wolf, 1963).

During the 2020 sampling period, the highest measurement of TSS (26.0 mg/l) was recorded at An-4.4 in July. Most samples throughout the monitoring period contained TSS concentrations in the range of 1-2 mg/l.

Total Dissolved Solids (TDS)

Total dissolved solids were measured in mg/l, using standard filtration, drying and weighing methods (APHA, 1995). The TDS reporting limit is 10 mg/l (Tables II.1 through II.3).

Total dissolved solids describe, in general terms, the concentrations of dissolved materials in the water which may include a variety of anions (carbonates, sulfates, chlorides, etc.) in combination with metallic cations (calcium, sodium, potassium, etc.) and infers a measure of salinity. The quantity and quality of dissolved solids are major factors determining the variety and abundance of plants and animals in the aquatic system (USEPA, 1986). Waters with more than 500 mg/l

TDS may be unsuitable for irrigation, and 500 mg/l TDS is also the approximate threshold for taste. Common freshwater fish species, however, have been shown to survive 10,000 mg/l dissolved solids (USEPA, 1986).

During 2020, the highest TDS level (190 mg/l) was recorded at CuC-0.1 in October. The lowest level (70 mg/l) was recorded at Gu-2.4 in July.

Turbidity

Turbidity of water samples was determined by the analytical laboratory. The reporting limit for turbidity levels was 0.10 nephelometric turbidity units (NTU) (Tables II.1 through II.3).

Turbidity is a measure of an optical property of water (Thurston *et al*., 1979) and is attributable to suspended and colloidal organic and inorganic matters that affect the penetration of light. For stream water designated for domestic use, the upper limit of 250 NTU has been recommended by McKee and Wolf (1963), who also indicated that turbidity levels over 400 NTU may be harmful to some fish life stages. The effects of high turbidity on aquatic organisms are similar to those of suspended solids.

During the 2020 sampling period, all measured turbidity values were well below the recommended criterion of 250 NTU. The highest recorded turbidity reading was 0.93 NTU, measured at Gu-0.6 in July.

Oil and Grease

Water samples were analyzed for oil and grease by the partition-gravimetric method (APHA, 1995). The reporting limit for the oil and grease analysis is 5.0 mg/l (Tables II.1 through II.3).

Chemicals collectively referred to as oils and greases are not definitive chemical categories, but include thousands of organic compounds with varying physical, chemical, and toxicological properties (USEPA, 1986). Petroleum-based oils and greases are hazardous to aquatic life in even trace amounts while those of animal and vegetable origin are generally nontoxic to most organisms. Because of the difficulty in determining the origin of oil and grease substances, and therefore their toxicity, there are currently no oil and grease criteria for toxicity.

During the 2020 sampling period, none of the collected samples exceeded the 5.0 mg/l reporting limit (Tables II.1 through II.3).

Alkalinity

Total alkalinity was determined by titration (APHA, 1995) and reported in mg/l as calcium carbonate equivalents. The reporting limit for alkalinity is 5.0 mg/l (Tables II.1 through II.3).

Alkalinity is the sum total of components in the water that tend to elevate the pH (*i.e.,* buffering capacity) of the water above a value of about 4.5. Alkalinity levels above 600 mg/l may be harmful to irrigated crops, and those above approximately 400 mg/l may be a problem to human health (USEPA, 1986). Alkalinity is important to aquatic life because it buffers pH changes and reduces the toxicity of some heavy metals (McMillan, 1985). There is no maximum criterion for aquatic life, but the USEPA (1986) has established a minimum level of 20 mg/l.

During 2020, as during previous monitoring periods, Gunning Creek stations had the lowest alkalinity levels, ranging from 39 to 43 mg/l. Alkalinity was highest at CuC-0.1; 200 mg/l in July. Alkalinity measurements never dropped below the recommended minimum level during the sample period.

Bicarbonate

Bicarbonate was determined by titration (APHA, 1995) and reported in mg/l (as calcium carbonate equivalents). The reporting limit for bicarbonate is 5.0 mg/l (Tables II.1 through II.3).

Bicarbonates may reach water by many natural sources, including absorption of carbon dioxide from the air and decomposition of organic material. Bicarbonates tend to reach an equilibrium with carbonates, and the amount of bicarbonates is dependent on the pH of the water and the concentration of carbonates. In general, bicarbonates are seldom considered to be detrimental, although excessive amounts add to the salinity and total solids of water (McKee and Wolf, 1963). There are no universal standards, but bicarbonate levels of less than 150 mg/l are desirable in drinking water (Hibbard, 1935).

During 2020, bicarbonate levels ranged from 48 mg/l at Gu-2.4 in April and July to 240 mg/l at CuC-0.1 in July.

Carbonate

Carbonate was determined by titration (APHA, 1995) and reported in mg/l (as calcium carbonate equivalents). The reporting limit for carbonate is 5.0 mg/l (Tables II.1 through II.3).

The amount of carbonate in water is a function not only of the substances added but also of the temperature, pH, cations and other dissolved salts; many carbonates are quite insoluble in water (McKee and Wolf, 1963). There are no generally accepted standards, but on the basis of taste considerations it is desirable for drinking waters to have less than 44 mg/l carbonate.

Carbonate concentrations never exceeded the 5 mg/l reporting limit during the 2020 monitoring period.

Hardness

During the 2020 sampling period, hardness was not analyzed by the analytical laboratory. However, hardness can be computed by multiplying the concentrations of the two primary cations responsible for hardness (Ca, Mg) by a constant to obtain equivalent calcium carbonate concentrations and then summing the equivalents (APHA, 1995). The following calculation was used to determine hardness from the reported calcium and magnesium concentrations:

$$\text{Hardness} = 2.497\ [\text{Ca, mg/l}] + 4.116\ [\text{Mg, mg/l}].$$

Calculated values are expressed in mg/l calcium carbonate and the reporting limit is 1.0 mg/l (Tables II.1 through II.3).

Hardness is dependent primarily on the amount of calcium and magnesium in the water. Samples containing zero to 75 mg/l are classed as soft water, and those with 150 to 300 mg/l are

considered hard water (USEPA, 1986). In terms of hardness, good quality domestic waters generally register below 250 mg/l. Water above 500 mg/l is undesirable because of precipitation and scale (Hach, 1983). Hard water tends to precipitate toxic metals as insoluble compounds; and, thus, may reduce negative effects on fish populations and other aquatic organisms. No water quality standards have been established for hardness; however, calculation of hardness allows for more accurate determination of toxicity criteria for some metals. Toxic effects of some metals may be lessened by increased water hardness.

Water hardness calculated during 2020 ranged from a low of 30 mg/l at Gu-2.4 in July to a high of 208 mg/l at CuC-0.1 in July. Waters in Bear Canyon and Cub Canyon creeks are relatively hard, and waters in Anderson and Gunning creeks are relatively soft.

Ammonia

The amount of total ammonia (ionized + unionized), based on ammonia-nitrogen, of the water samples was determined using the automated phenate method (APHA, 1995) and values are reported in milligrams of nitrogen per liter (mg N/l). The reporting limit for this analysis is 0.10 mg N/l (Tables II.1 through II.3).

Ammonia concentrations in water samples naturally occur as a product of organic decomposition. In the Geysers drainages, ammonia may also be contributed by natural geothermal surface activity and industrial geothermal activities, principally cooling tower drift (Ireland and Carter, 1980). The revised USEPA (1999a) criteria for protection of aquatic life are based on the pH and temperature of the water. For waters where early life stages of fish are present, the water temperature is below 14°C, and the pH is 8.0, the chronic criterion (30-days average) is 2.43 mg N/l. The acute criterion (1-hour average) for waters at a pH of 8.0 and containing salmonids is 5.62 mg N/l. Please refer to other pH and temperature-specific criteria in USEPA (1999a). The BC/WFF water quality monitoring involves the collection of one-time grab samples. Thus, neither the 1-hour nor the 30-day average concentrations can be determined.

During 2020, only one collected sample slightly exceeded the 0.20 mg N/l ammonia reporting limit: 0.26 mg N/l at An-4.4 in July. Thus, neither the acute nor the chronic criterion was exceeded in the non-averaged grab samples.

The KGRA-ARM study reported values of ammonia in 1981-82 and 1982-83 that ranged from less than 0.02 mg N/l at Anderson, Cub Canyon and Bear Canyon creeks to 2.0 mg N/l at Gunning Creek. Levels of ammonia for the BC/WFF study were high in 1990-91 (above 1.0 mg N/l) and again in 1992-93 (above 2.0 mg N/l). In October 2006, ammonia concentrations of 3.6 and 2.4 mg N/l were observed at An-4.4 and Gu-0.6, respectively. Ambient water conditions at the time of sample collection included a pH value of 8.0 and water temperature below 14°C. Thus, while the acute criterion of 5.62 mg N/l was not exceeded, the chronic criterion of 2.43 mg N/l was exceeded at An-4.4 and reached at Gu-0.6. A similar result was recorded at Gu-0.6 during the summer of the 2005-2006 monitoring year. The reasons for these unusually high levels of ammonia were not evident, but since April 2007, ammonia concentrations at all sampling sites have been well below established criteria.

Nitrate

Nitrate was measured by an ion chromatography method (APHA, 1995). Levels are reported in milligrams of nitrogen per liter (mg N/l). The reporting limit for this analysis is 1.0 mg N/l (Tables II.1 through II.3).

Nitrates that occur in water are often normal decomposition products of organic materials. Nitrate is also the common form in which nitrogen is added as fertilizer to agricultural crops and revegetation projects. Nitrates may also be present in geothermal steam as a result of ammonia oxidation (McMillan, 1985). The nitrate criterion for domestic water is 10.0 mg N/l (USEPA, 1986). However, tested fish species have proved tolerant of levels that are higher than would be expected in any freshwater body; thus, no criteria are recommended (USEPA, 1986).

During 2020, none of the collected nitrate samples exceeded the 1.0 mg N/l reporting limit.

Sulfate

Sulfate was measured by an ion chromatography method (APHA, 1995). Levels are reported in mg/l and the reporting limit for this analysis is 0.5 mg/l (Tables II.1 through II.3).

Sulfates appear in natural streams in a wide range of concentrations, often because of mineral leaching and the oxidation of sulfurous material associated with mining operations. Sulfate is common in geothermal steam and may also be produced during hydrogen sulfide abatement (McMillan, 1985). According to Ireland and Carter (1980) geothermal units are implicated as significant contributors to the input of sulfate into aquatic systems, and the most probable transport process is cooling tower drift. The USEPA has not set a freshwater criterion, but most waters with healthy populations of game fish have less than 90 mg/l (McKee and Wolf, 1963).

Levels of sulfates during the 2020 sampling year ranged from a high of 11.0 mg/l at An-2.8 in April to a low of 0.50 mg/l at Gu-0.6 in July. On average, Bear Canyon and Cub Canyon Creek typically contain the highest sulfate levels during a given sampling period, while Gunning Creek consistently contains the lowest levels. Sulfate concentrations recorded during this period were all well below the suggested level for healthy fish populations.

Chloride

Chloride concentrations were measured by an ion chromatography method (APHA, 1995). Levels are reported in mg/l and the reporting limit for this analysis is 0.50 mg/l (Tables II.1 through II.3).

Chloride is present in nearly all water supplies, usually as a metallic salt. In drinking water, chloride concentrations in excess of 250 mg/l give a salty taste. Chlorides in drinking water are not usually harmful until high concentrations are reached, and large amounts may act corrosively on metal pipes and be harmful to plant life. The USEPA (1988) acute criterion for chloride in freshwater is 860 mg/l and the chronic criterion is 230 mg/l.

Levels of chloride during the 2020 sampling period ranged from a low of 1.1 mg/l at Gu-2.4 in July to a high of 2.7 mg/l at BeC-0.5 in April.

Hydrogen Ion Concentration (pH)

Hydrogen ion concentrations (pH) was measured in the field using an Aquacheck Model A51600. Measured values were recorded to the nearest 0.1 pH unit.

The logarithm of the reciprocal of the hydrogen ion concentration is known as pH; consequently, a change of one pH unit represents a tenfold increase in hydrogen ion concentration. The solubility of metals in sediments and suspended material and the toxicity of many compounds are affected by pH. The USEPA (1999) has established a pH range of 6.5 to 9.0 for the protection of freshwater aquatic life.

During 2020, the pH of tested waters ranged from 7.8 at BeC-0.5 in October to 8.9 at Gu-0.6 in July. Neither the lower nor the upper USEPA criterion was surpassed.

II.2.2 Coliform Bacteria

The coliform bacteria, organisms commonly found in human (and other mammalian) feces, comprise all of the aerobic and facultative anaerobic, gram-negative, non-endospore forming, and rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C (APHA, 1995). These organisms are used in the water quality analysis as indicative of fecal waste pollution, because some coliform bacteria are not enteric (found in the digestive system) but are found in plant and soil samples. Therefore, fecal coliform counts are often made to distinguish between the two.

Total coliform and fecal coliform bacteria were measured using multiple tube fermentation techniques as described in Standard Methods (APHA, 1995) and reported as the most probable number (MPN) of bacteria per 100 ml of water sample. The reporting limit for the coliform analysis is 1.8 MPN (Tables II.1 through II.3). Treated or chlorinated drinking water should contain no coliform bacteria per 100 ml of sample (APHA, 1985); coliform bacteria in untreated water samples are to be expected.

Total Coliform

Total coliform levels during the 2020 sampling period ranged from a low of 79 MPN at Gu-2.4 in April to highs equaling or exceeding the upper reporting limit of 1,600 MPN at An-2.4 in April and July, at BeC-0.5 and CuC-0.1 in July and October, and at Gu-0.6 in July.

Fecal Coliform

Fecal coliform levels during the 2020 sampling period varied from a low of “none detected” at Gu-2.4 and CuC-.1 in April to a high of 920 MPN at Gu-0.6 in July.

High fecal coliform counts, coupled with the high total coliform count, occurred at BeC-0.5 during the dry seasons of 2000 and 2001 (ESA, 2001; ESA 2002). This problem was not evident in 2002 and coliform counts at this site were lower still in July 2002 – April 2003. However, elevated coliform levels in Bear Canyon Creek were again evident in July and October 2003. In 2004, 2005, 2006, no such elevated levels were observed, but high concentrations were again observed in July 2007. High total and fecal coliform counts were once again evident at BeC-0.5 in November 2016 and July 2017, but not in 2018. High fecal coliform counts occurred again in

Bear Canyon Creek and one of its tributaries, Cub Canyon Creek, in July 2019, but were considerably lower in 2020. Leaking septic systems are the likely cause of occasionally high coliform levels in the monitored streams.

II.2.3 Element Concentrations

The concentrations of 15 chemical elements dissolved in the collected water samples were analyzed using inductively coupled plasma (ICP) atomic emission spectrometry and ICP mass spectrometry. Grab samples from midstream and mid-depth were preserved on ice and mailed to the analytical laboratory within 24 hours for acid preservation and analysis. Results are reported in milligrams per liter (mg/l) unless otherwise stated. The reporting limits for each parameter, as well as the results of the individual analyses, are presented in Tables II.1 through II.3. Where appropriate, comparisons have been made to selected elements for stations on Anderson, Gunning, and Bear Canyon creeks in the KGRA-ARM report (McMillan, 1985) for the sampling years 1981-82 and 1982-83.

Calcium (Ca)

Calcium is an essential macronutrient for both plants and animals. It is the fifth most common element and is considered to be nontoxic. Calcium is present in most natural water at concentrations from zero to several hundred milligrams (APHA, 1985). Calcium is customarily added to water as it passes through or over calcium-rich geologic formations. Calcium contributes substantially to the hardness of water. Large amounts of calcium salts may precipitate in pipes and boilers as an undesirable scale. There are no established water quality standards for this element.

During 2020, calcium levels ranged from 7.1 mg/l at Gu-2.4 in July and October to 25 mg/l at BeC-0.5 in July.

Among the streams monitored, Gunning Creek typically contains the least calcium, while Bear Canyon Creek and Cub Canyon Creek contain the most.

Magnesium (Mg)

Magnesium is an essential macronutrient for plants and animals and is the eighth most abundant earth element. It is a common constituent of water and contributes significantly to hardness properties. Natural concentrations in surface water may range from zero to several hundred milligrams per liter. Concentrations in excess of 125 mg/l can have a cathartic and diuretic effect on humans (APHA, 1985).

During 2020, magnesium levels ranged from a low of 3.1 mg/l at Gu-2.4 during each sampling event to a high of 36 mg/l at CuC-0.1 in July.

In general, the amounts of magnesium in the surface waters of the study area are typically low in Gunning Creek, moderate in Andersen Creek, and higher in Bear Canyon and Cub Canyon creeks.

Aluminum (Al)

Aluminum is the third most abundant metallic element in the earth's crust. The element is not known to have a nutritional function in organisms and may be toxic to life in high concentrations and acidic environments (Lepp, 1981). McKee and Wolf (1963) suggest an upper limit of 0.07 mg/l for the protection of fish and their ova, and the USEPA (2006) recommends a chronic criterion of 0.087 mg/l and an acute criterion of 0.75 mg/l. However, USEPA (2006) also notes that "many high-quality waters in the U.S. contain more than 0.087 mg/l aluminum."

During the 2020 sampling period, the highest recorded aluminum concentration of 0.067 mg/l occurred at An-2.8 in July. As such, the USEPA-recommended acute criterion was not exceeded during the monitoring period. However, the sampling frequency used for the BC/WFF program are insufficient for a determination of compliance with, or exceedance of, the chronic criterion.

The KGRA-ARM study showed values in 1981-1982 and 1982-1983 that ranged from less than 0.006 mg/l of aluminum on Gunning Creek to 4.0 mg/l on Anderson Creek. Since 1990, aluminum levels have, for the most part, decreased substantially at all BC/WFF stations. Slight increases in aluminum concentrations (as high as 0.285 mg/l) were detected during 1994-1995 on Bear Canyon and Cub Canyon creeks. Gunning Creek also had elevated aluminum concentrations during 2005-2006, and again in July 2013, 2014, and 2016. Anderson Creek had elevated aluminum concentrations during the 2005-2006, 2006-2007, 2007-2008, 2011-2012, and 2012-2013 monitoring periods, and again in 2016. The reasons for the occasional observed increases in aluminum concentrations at BC/WFF stations are unclear.

Arsenic (As)

Arsenic seldom occurs in drinking water above 0.010 mg/l (APHA, 1985). Arsenic is naturally found in the Geysers environment, and it is present in steam condensate, cooling water and cooling tower sludge (McMillan, 1985; Borgias, 1982). Arsenic is a known carcinogen and a poison. Poisoning in humans may occur from arsenic accumulation in the body at low intake levels. Although water hardness does not affect arsenic toxicity, higher temperatures may increase toxicity. According to the USEPA (1986) aquatic life may be adversely affected if the one-hour average of arsenic (III) concentration exceeds 0.360 mg/l more than once every three years. The analytical method used does not distinguish between the different forms of arsenic, therefore detected levels are assumed to be the most toxic form, arsenic (III). California State Department of Health Services (CSDOH) (1977) states a maximum contaminant level for arsenic of 0.050 mg/l in drinking water.

During the 2020 monitoring period, recorded arsenic concentrations never exceeded the 0.002 mg/l reporting limit. Thus, the USEPA criterion was not exceeded.

The KGRA-ARM study showed values of arsenic in 1981-1982 and 1982-1983 that ranged from less than 0.002 mg/l on Anderson, Gunning, and Bear Canyon creeks to a high of 0.004 mg/l on Bear Canyon Creek. Although arsenic levels were relatively high for the BC/WFF study in 1990 and 1991 (up to 0.05 mg/l) for Anderson, Bear Canyon and Cub Canyon creeks, recorded concentrations have generally been low since 1992.

Barium (Ba)

Barium is a yellowish-white metal of the alkaline earth group. It occurs in nature chiefly as barite and witherite, both of which are highly insoluble salts. Many of the salts of barium are soluble in both water and acid, and soluble barium salts are reported to be poisonous (USEPA, 1986). However, barium ions generally are thought to be rapidly precipitated or removed from solution by absorption and sedimentation (McKee and Wolf, 1963). The fatal dose of barium for humans is reported to be 550 to 600 mg (USEPA, 1986). The acceptable barium limit for human health is 2 mg/l, but concentrations would have to exceed 50 mg/l before toxicity to aquatic life would be expected (USEPA, 1986).

During the 2020 sampling year, the highest recorded barium concentration was 0.092 mg/l at An-4.4 in July. Therefore, all measured barium concentrations were well below the USEPA recommendation.

In the past, barium concentrations were typically less than the 0.10 mg/l reporting limit. However, the use of a significantly lower reporting limit (0.002 mg/l) by the Alpha Analytical Laboratories, Inc. has resulted in consistently measurable barium concentrations.

Boron (B)

Boron is commonly associated with natural geothermal waters and the production of geothermal steam. Although small amounts of boron are essential for plant growth, concentrations in irrigation water in excess of 0.5 mg/l may harm sensitive species; yet, 0.75 mg/l is safe for most plants (Marshack, 1985). Localized boron toxicity to woody vegetation as a result of steam fallout was documented at the Geysers during the early years of geothermal development (Malloch *et al*., 1979). However, continued boron drift monitoring has shown a steady decrease in boron concentrations in plants surrounding geothermal power plants (LandWatch, 2003). Furthermore, 20 years of monitoring have revealed no significant impacts to nearby vegetation (LandWatch, 2003). Boron is not generally considered to be a health hazard to humans and animals (Nolte and Associates, 1985). Drinking water concentrations of less than 0.1 mg/l are generally considered innocuous (APHA, 1985).

During 2020, only one sample contained boron concentrations exceeding the 0.20 mg/l reporting limit: 0.25 mg/l at An-4.4 in July. Therefore, all measured boron concentrations were lower than the amount safe for plants and sensitive species.

Cadmium (Cd)

Cadmium is highly toxic to humans and other animals. A concentration of 0.002 mg/l has been found to be lethal to certain fish, and minute quantities of cadmium are suspected of causing certain cancers and adverse changes in human arteries and kidneys (APHA, 1985). Drinking waters in the U.S. have a mean of about 0.008 mg/l cadmium. USEPA (1986) human health criterion for the ingestion of water containing cadmium is 0.010 mg/l. The criteria for the protection of aquatic organisms are dependent on hardness. For example, at a water hardness of 100 mg/l calcium carbonate the 4-day average of total recoverable cadmium should not exceed 1.1 µg/l (=0.0011 mg/l), and at a hardness of 200 mg/l cadmium should not exceed 2.0 µg/l (=0.002 mg/l) more than once every three years (USEPA, 1986).

During the 2020 sampling year, recorded cadmium concentrations never exceeded the 0.0004 mg/l reporting limit. Therefore, established cadmium criteria were never exceeded.

The KGRA-ARM study showed cadmium levels for 1981-1982 and 1982-1983 that ranged from less than 0.003 mg/l to less than 0.001 mg/l in Anderson, Gunning, and Bear Canyon creeks. For the BC/WFF study, stations on Anderson, Gunning and Bear Canyon creeks frequently had cadmium levels above 0.01 mg/l in 1988 and 1989. However, from 1989 through 2020, cadmium levels have been well below 0.01 mg/l.

Chromium (Cr)

Chromium is a toxic metal and a suspected carcinogen. Hexavalent chromium is more toxic to humans and aquatic life than is the trivalent form. Chromium may occur in natural water in both forms but is usually found in the hexavalent state. The method used for the analysis of chromium did not distinguish between molecular species; thus, values reported for BC/WFF reflect total chromium. According to Marshack (1985) criteria for hexavalent chromium should be used when chromium valence is not known. For the protection of freshwater organisms, the concentration of hexavalent chromium should not exceed 0.016 mg/l on a one-hour average, and 0.011 mg/l on a four-day average, more than once every three years (USEPA, 1986).

During the 2020 monitoring year, the highest recorded chromium concentrations was 0.0047 mg/l at CuC-0.1 in April. The BC/WFF water quality monitoring involves the collection of one-time grab samples. Thus, neither the one-hour nor the four-day average concentrations can be determined. Nevertheless, the criteria for the protection of freshwater organisms were not exceeded on the sampling dates.

In 1994-1995, the criterion was surpassed at An-2.8 (0.013 mg/l) and BeC-0.5 (0.027 mg/l) in October.

Copper (Cu)

Copper is an essential micronutrient for both plants and animals. Copper salts, in quantities exceeding physiological demands, are also used to control algal growths in water supplies. The recommended USEPA (1986) criterion for protection of freshwater aquatic life is dependent on water hardness. For example, the one-hour average concentration of copper should not exceed 0.018 mg/l at a hardness of 100 mg/l calcium carbonate and 0.034 mg/l at a hardness of 200 mg/l; the four-day average concentration of copper should not exceed 0.012 mg/l at a hardness of 100 mg/l calcium carbonate and 0.021 mg/l at a hardness of 200 mg/l, respectively. The USEPA (1986) drinking water standard, based on taste and odor, is 1.0 mg/l.

During the 2020 monitoring year, the highest recorded copper concentration of 0.0028 mg/l occurred at CuC-0.1 in October. The BC/WFF water quality monitoring involves the collection of one-time grab samples. Thus, neither the one-hour nor the four-day average concentrations can be determined. Nevertheless, the criterion for the protection of freshwater organisms via USEPA was never exceeded at the time of sampling.

The KGRA-ARM study showed levels of copper for 1981-82 and 1982-83 that ranged from less than 0.002 mg/l on Anderson, Gunning and Bear Canyon creeks to 0.008 mg/l on Anderson Creek. In the BC/WFF study copper levels were fairly high in 1989, reaching levels above 0.01 mg/l on Anderson Creek. Copper levels were lower (never greater than 0.008 mg/l) from 1991 through early 1993 at all stations. In mid-1993, there was a single occurrence of an elevated copper level (0.018 mg/l) on Anderson Creek, though subsequent recorded concentrations from late 1993 through 2020 have not exceeded 0.01 mg/l.

Iron (Fe)

Iron is an essential macronutrient for both plants and animals. This element occurs universally in natural waters, commonly in minor amounts. Iron can enter watercourses by leaching of natural deposits, from iron-bearing industrial wastes or emissions, and from acidic mine wastes (Hach, 1983). Iron compounds are sometimes used in hydrogen sulfide abatement associated with geothermal energy production. Iron precipitates can be detrimental to aquatic life (McMillan, 1985). A maximum level of 1 mg/l has been set by the USEPA (1986) for the protection of freshwater aquatic life, and on the basis of taste and aesthetics an upper limit of 0.300 mg/l has been recommended for domestic water supplies.

During the 2020 sampling year, none of the samples exceeded the 0.200 mg/l iron detection limit. Thus, all obtained values were below the USEPA criterion for the protection of aquatic life.

The KGRA-ARM study reported values for iron in 1981-82 and 1982-83 that ranged from 0.03 mg/l on Gunning Creek to 2.0 mg/l on Anderson Creek. Although iron levels were relatively high during the 1990-91 BC/WFF sampling period (high of 0.711 mg/l), values have generally remained below 0.5 mg/l since 1992.

Lead (Pb)

Lead is a toxic element that accumulates in animals. Lead is present in geothermal steam condensates (Borgias, 1982) and may be added to water supplies via lead-rich geologic deposits. Lead tends to be precipitated by numerous substances, effectively reducing levels found in flowing water. Natural waters seldom have more than 0.02 mg/l, although lead values up to about 0.4 mg/l have been reported (APHA, 1985). Lead toxicity in the aquatic environment is influenced by pH, alkalinity and hardness. McKee and Wolf (1963) have reported lead poisoning in humans to be caused by drinking water with as low as 0.042 mg/l lead. The lead criteria for protection of freshwater aquatic life as proposed by the USEPA (1986) are dependent on water hardness and duration of exposure. For example, at a hardness of 100 mg/l calcium carbonate, the concentration of lead should not exceed 0.082 mg/l on a one-hour average, and 0.0032 mg/l on a four-day average, more than once every three years. At a hardness of 200 mg/l, the criteria increase to 0.200 and 0.0077 mg/l, respectively. A lead concentration of 0.050 mg/l has been established for domestic water supplies (USEPA, 1986).

None of the 2020 water samples contained lead levels above the reporting limit of 0.001 mg/l.

The KGRA-ARM study showed lead values in 1981-82 and 1982-83 that ranged from less than 0.001 mg/l on Anderson, Gunning and Bear Canyon creeks to 0.002 mg/l on Gunning Creek.

Although lead levels were relatively high in the BC/WFF study for much of 1988 and 1990 (>0.05 mg/l), levels have remained low from 1990 through 2020.

Mercury (Hg)

Organic and inorganic mercury salts are very toxic (APHA, 1985), and mercury is naturally associated with geothermal surface waters. In the past, mercury mining occurred in many places in the Geysers region, including the Anderson Creek drainage. Mercury is present in geothermal steam condensate, cooling water and cooling tower sludge (McMillan, 1985). The USEPA (1986) criteria for the protection of freshwater organisms are dependent on duration of exposure. For example, the concentration of mercury (II) should not exceed 0.0024 mg/l on a one-hour average and 0.00012 mg/l on a four-day average, more than once over a three-year period. The analytical method used does not distinguish between the different forms of mercury, therefore detected levels are assumed to be the most toxic form, mercury (II). CSDOH (1977) states that 0.002 mg/l mercury is the maximum contaminant level for water used continually for drinking or culinary purposes.

During the 2020 sampling period, mercury concentrations did not exceed 0.0002 mg/l reporting limit. The 1-hour criterion for the protection of freshwater organisms was not exceeded during the sampling period. However, as the reporting limit for mercury analysis is slightly higher than the four-day average criterion, and due to the non-averaging grab sample nature of the monitoring program, compliance with the four-day average criterion could not be determined.

Brown and Caldwell Consulting (1985) reported a single occurrence of an elevated mercury level (0.0048 mg/l) on Gunning Creek. The KGRA-ARM report showed values for 1981-1982 and 1982-1983 that ranged from less than 0.0001 mg/l on Anderson and Bear Canyon creeks to a high of 0.0005 mg/l on Bear Canyon Creek.

Selenium (Se)

Excessive selenium may present a health hazard to humans. Selenium has been reported to affect normal embryo development in domestic animals (USEPA, 1980), and it may similarly affect fish and wildlife (Davis *et al*., 1988). Tissue concentrations of selenium in excess of 2 mg/l may cause toxic effects in sensitive species of fish. However, small quantities of selenium are beneficial, and its role as an essential micronutrient is assumed for humans and other animals. For selenium, the USEPA (1986) has established a drinking water standard of 10 µg/l (=0.010 mg/l) for the protection of public health. However, the analytical methods employed did not distinguish elemental selenium from the more toxic selenite form of selenium. The aquatic life criterion for exposure to selenite is 35 µg/l (=0.035 mg/l) as a 24-hour average.

During the 2020 sampling period, selenium concentrations did not exceed the 0.008 mg/l lower reporting limit.

The KGRA-ARM study showed selenium values for 1981-82 and 1982-83 that ranged from less than 0.002 mg/l on Anderson, Gunning and Bear Canyon creeks to a high of 0.004 mg/l on Bear Canyon Creek. For the BC/WFF study, selenium levels on Anderson, Gunning and Bear Canyon creeks were relatively high in 1988, 1989, and 1990 (greater than 0.15 mg/l), but values remained

low from 1991 through 2019. In October 2009, one selenium sample exceeded the lower reporting limit (0.0094 mg/l at BeC-0.5), but the level was not high enough to exceed the drinking water standards (ESA, 2010).

Vanadium (V)

Vanadium is a common element in soils, and some of its compounds may benefit humans by reducing dental caries and blood cholesterol levels (McMillan, 1985). However, vanadium pentoxide, which has been used in hydrogen sulfide abatement at the Geysers, can cause gastrointestinal and respiratory disturbances (APHA, 1985). Although vanadium is present in geothermal sludge (Borgias, 1982), it is not known if this element is present in cooling tower drift. In the U.S., drinking water supplies have a mean concentration of 0.006 mg/l. Fish may be adversely affected by as little as 4.8 mg/l in soft water and 30 mg/l in hard water (McKee and Wolf, 1963). The USEPA's estimated permissible ambient goal, based on health, is 0.007 mg/l (USEPA, 1986).

During the 2020 sampling period, the highest recorded vanadium concentration of 0.0064 mg/l occurred at An-2.8 and Gu-2.4 in October. Thus, vanadium levels remained well below the levels that could affect fish.

Zinc (Zn)

Zinc is an element essential for human growth and for many aquatic organisms. The mean zinc concentration in U.S. drinking waters is 1.33 mg/l; when in concentrations greater than 5 mg/l it affects taste. Acute toxicity of aquatic organisms has been demonstrated in concentrations as low as 0.090 mg/l, and a 24-hour criterion of 0.047 mg/l has been suggested for the protection of freshwater organisms (USEPA, 1986). In the Geysers region, additional zinc may be added to surface waters by deterioration of galvanized iron, runoff from mine tailings, input from hot springs and fallout from geothermal steam.

During 2020, none of the collected water samples contained zinc levels above the reporting limit of 0.020 mg/l. Therefore, the USEPA criterion of 0.047 mg/l for the protection of freshwater organisms was not exceeded.

The KGRA-ARM study showed zinc concentrations in 1981-1982 and 1982-1983 that ranged from less than 0.001 mg/l on Anderson, Gunning and Bear Canyon creeks to 0.06 mg/l on Gunning Creek. Zinc levels for the BC/WFF study were sporadically above 0.04 mg/l in 1988-89 on Anderson, Bear Canyon and Gunning creeks, and also in 1990 on Bear Canyon and Gunning creeks. Levels of zinc above 0.1 mg/l were reached in 1988 on Gunning Creek and in 1992 on Bear Canyon and Cub Canyon creeks. During late 1994, zinc levels exceeded 0.1 mg/l on Anderson, Gunning, Bear Canyon and Cub Canyon creeks.

II.3 Discussion

As during prior years, the results of the 2020 BC/WFF water quality analyses are again reflective of the relatively undisturbed conditions in the Anderson Creek watershed. All sampled

parameters were below applicable water quality criteria established by the EPA.[1] The Valley Fire burned much of the BC/WFF sampling area in September 2015. Nevertheless, no significant long-term, post-fire water quality effects are apparent from the available data.

[1] Water quality criteria testing performed by Alpha Analytical Labs, Inc., used standard EPA testing methodologies. These include the methodology for metals by EPA 200 Series Methods; conventional chemistry parameters by APHA/EPA Methods; Aluminum by total ICP 200.7 EPA; Chromium by total ICP 200.7 EPA; pH by SM4500; Solids by TSS-SM2540D.

TABLE II.1

WATER QUALITY ANALYSES RESULTS, APRIL 2020

Parameter	RL	An-2.8	An-4.4	Gu-0.6	Gu-2.4	BeC-0.5	CuC-0.1	Mean
Date	---	4/16	4/16	4/16	4/16	4/16	4/16	---
Time	---	1215	1000	1115	1030	1145	0900	---
Air Temp (°C)	**0.1**	22.2	16.1	16.7	19.4	18.9	13.3	**17.8**
Water Temp (°C)	**0.1**	15.2	11.4	12.7	12.3	14.1	11.7	**12.9**
Conduct. (µmhos/cm)	**1**	180	170	80	80	270	290	**178**
DO Conc. (mg/l)	**0.1**	9.1	9.8	9.5	9.5	9.1	9.9	**9.5**
DO Sat. (%)	**1**	93	90	90	89	90	91	**91**
Flow (cfs)	**0.01**	4.81	0.92	4.53	1.09	2.83	0.40	**2.43**
TSS (mg/l)	**1.0**	1.0	ND	1.4	1.2	ND	ND	**ND**
TDS (mg/l)	**10**	120	110	80	73	140	160	**114**
Turbidity (NTU)	**0.10**	0.69	0.41	0.80	0.64	0.28	0.26	**0.51**
Oil & Grease (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Alkalinity (mg/l)	**5.0**	90	88	41	39	140	170	**95**
Bicarbonate (mg/l)	**5.0**	110	110	50	48	180	210	**118**
Carbonate (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Hardness (mg/l)	**1**	96	86	32	31	157	183	**98**
Ca (mg/l)	**1.0**	17.0	18.0	7.4	7.2	20.0	19.0	**14.8**
Mg (mg/l)	**1.0**	13.0	10.0	3.3	3.1	26.0	33.0	**14.7**
Ammonia (mg/l)	**0.20**	ND	ND	ND	ND	ND	ND	**ND**
Nitrate (mg N/l)	**1.0**	ND	ND	ND	ND	ND	ND	**ND**
Sulfate (mg/l)	**0.50**	11.0	7.6	1.0	0.79	8.3	3.9	**5.43**
Chloride (mg/l)	**0.50**	1.7	1.6	1.4	1.2	2.7	2.2	**1.8**
pH (pH units)	**0.1**	8.4	8.3	8.1	8.0	8.4	8.6	**8.3**
Total Coliform (MPN)	**1.8**	>1600	540	540	79	350	350	**>577**
Fecal Coliform (MPN)	**1.8**	2.0	2.0	2.0	ND	2.0	ND	**ND**
Al (mg/l)	**0.040**	0.049	ND	0.053	0.047	ND	ND	**ND**
As (mg/l)	**0.0020**	ND	ND	ND	ND	ND	ND	**ND**
Ba (mg/l)	**0.0020**	0.059	0.091	0.019	0.011	0.058	0.048	**0.048**
B (mg/l)	**0.200**	ND	0.250	ND	ND	ND	ND	**ND**
Cd (mg/l)	**0.00040**	ND	ND	ND	ND	ND	ND	**ND**
Cr (mg/l)	**0.0020**	ND	ND	ND	ND	0.0030	0.0047	**ND**
Cu (mg/l)	**0.0020**	ND	ND	ND	ND	ND	ND	**ND**
Fe (mg/l)	**0.200**	ND	ND	ND	ND	ND	ND	**ND**
Pb (mg/l)	**0.001**	ND	ND	ND	ND	ND	ND	**ND**
Hg (mg/l)	**0.00020**	ND	ND	ND	ND	ND	ND	**ND**
Se (mg/l)	**0.0080**	ND	ND	ND	ND	ND	ND	**ND**
V (mg/l)	**0.0030**	ND	ND	ND	ND	ND	ND	**ND**
Zn (mg/l)	**0.020**	ND	ND	ND	ND	ND	ND	**ND**

NOTE: RL = Reporting Limit; ND = None Detected at RL; NA = Not Available; --- = Not Applicable.

TABLE II.2

WATER QUALITY ANALYSES RESULTS, JULY 2020

Parameter	RL	An-2.8	An-4.4	Gu-0.6	Gu-2.4	BeC-0.5	CuC-0.1	Mean
Date	---	7/22	7/22	7/22	7/22	7/22	7/22	---
Time	---	1300	1030	1145	1100	1225	0945	---
Air Temp (°C)	**0.1**	35.0	23.3	32.2	27.8	26.7	22.8	**28.0**
Water Temp (°C)	**0.1**	13.9	14.6	14.4	13.4	13.8	14.8	**14.2**
Conduct. (µmhos/cm)	**1**	110	150	84	79	260	330	**169**
DO Conc. (mg/l)	**0.1**	9.7	9.1	9.4	9.3	7.7	8.8	**9.0**
DO Sat. (%)	**1**	95	90	94	90	76	87	**89**
Flow (cfs)	**0.01**	1.20	0.33	0.63	0.51	0.22	0.11	**0.50**
TSS (mg/l)	**1.0**	ND	26.0	ND	1.0	4.3	1.9	**5.5**
TDS (mg/l)	**10**	94	110	71	70	150	140	**106**
Turbidity (NTU)	**0.10**	0.30	0.42	0.93	0.35	0.82	0.89	**0.62**
Oil & Grease (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Alkalinity (mg/l)	**5.0**	65	76	43	39	150	200	**96**
Bicarbonate (mg/l)	**5.0**	79	93	52	48	180	240	**115**
Carbonate (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Hardness (mg/l)	**1**	55	73	32	30	165	208	**94**
Ca (mg/l)	**1.0**	10.0	16.0	7.5	7.1	25.0	24.0	**14.9**
Mg (mg/l)	**1.0**	7.2	8.0	3.3	3.1	25.0	36.0	**13.8**
Ammonia (mg/l)	**0.20**	ND	0.26	ND	ND	ND	ND	**ND**
Nitrate (mg N/l)	**1.0**	ND	ND	ND	ND	ND	ND	**ND**
Sulfate (mg/l)	**0.50**	1.9	5.0	0.50	ND	8.8	6.1	**3.7**
Chloride (mg/l)	**0.50**	1.5	1.6	1.3	1.1	2.4	2.2	**1.7**
pH (pH units)	**0.1**	8.5	8.2	8.9	8.0	8.0	8.6	**8.4**
Total Coliform (MPN)	**1.8**	>1600	540	>1600	920	>1600	1600	**510**
Fecal Coliform (MPN)	**1.8**	33.0	21.0	920	14.0	130	23.0	**190**
Al (mg/l)	**0.040**	0.067	ND	ND	ND	0.054	0.044	**ND**
As (mg/l)	**0.0020**	ND	ND	ND	ND	ND	ND	**ND**
Ba (mg/l)	**0.0020**	0.045	0.092	0.022	0.012	0.084	0.077	**0.055**
B (mg/l)	**0.200**	ND	ND	ND	ND	ND	ND	**ND**
Cd (mg/l)	**0.00040**	ND	ND	ND	ND	ND	ND	**ND**
Cr (mg/l)	**0.0020**	0.0020	ND	ND	ND	ND	0.0035	**ND**
Cu (mg/l)	**0.0020**	0.0026	ND	ND	ND	ND	ND	**ND**
Fe (mg/l)	**0.200**	ND	ND	ND	ND	ND	ND	**ND**
Pb (mg/l)	**0.001**	ND	ND	ND	ND	ND	ND	**ND**
Hg (mg/l)	**0.00020**	ND	ND	ND	ND	ND	ND	**ND**
Se (mg/l)	**0.0080**	ND	ND	ND	ND	ND	ND	**ND**
V (mg/l)	**0.0030**	0.0030	ND	ND	ND	ND	ND	**ND**
Zn (mg/l)	**0.020**	ND	ND	ND	ND	ND	ND	**ND**

NOTE: RL = Reporting Limit; ND = None Detected at RL; NA = Not Available; --- = Not Applicable.

TABLE II.3

WATER QUALITY ANALYSES RESULTS, OCTOBER 2020

Parameter	RL	An-2.8	An-4.4	Gu-0.6	Gu-2.4	BeC-0.5	CuC-0.1	Mean
Date	---	10/15	10/15	10/15	10/15	10/15	10/15	---
Time	---	1000	1055	1210	1125	1030	0850	---
Air Temp (°C)	**0.1**	16.7	12.2	16.7	13.3	15.0	11.1	**14.2**
Water Temp (°C)	**0.1**	12.8	11.1	17.2	11.2	12.2	12.9	**12.9**
Conduct. (µmhos/cm)	**1**	100	120	80	77	230	310	**153**
DO Conc. (mg/l)	**0.1**	9.6	9.3	9.6	9.7	9.4	9.6	**9.5**
DO Sat. (%)	**1**	92	85	90	89	88	91	**89**
Flow (cfs)	**0.01**	2.19	1.32	1.92	0.98	0.41	0.10	**1.15**
TSS (mg/l)	**1.0**	1.4	ND	ND	ND	ND	ND	**ND**
TDS (mg/l)	**10**	94	110	94	76	160	190	**121**
Turbidity (NTU)	**0.10**	ND	ND	ND	0.15	0.10	ND	**ND**
Oil & Grease (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Alkalinity (mg/l)	**5.0**	60	73	43	41	140	190	**91**
Bicarbonate (mg/l)	**5.0**	73	89	52	50	170	230	**111**
Carbonate (mg/l)	**5.0**	ND	ND	ND	ND	ND	ND	**ND**
Hardness (mg/l)	**1**	50	65	32	30	144	197	**86**
Ca (mg/l)	**1.0**	9.4	14.0	7.4	7.1	23.0	23.0	**14.0**
Mg (mg/l)	**1.0**	6.5	7.2	3.3	3.1	21.0	34.0	**12.5**
Ammonia (mg/l)	**0.20**	ND	ND	ND	ND	ND	ND	**ND**
Nitrate (mg N/l)	**1.0**	ND	ND	ND	ND	ND	ND	**ND**
Sulfate (mg/l)	**0.50**	1.8	4.6	0.67	0.58	8.7	8.2	**4.1**
Chloride (mg/l)	**0.50**	1.5	1.6	1.3	1.2	2.1	2.0	**1.6**
pH (pH units)	**0.1**	8.1	8.2	8.0	7.9	7.8	8.5	**8.1**
Total Coliform (MPN)	**1.8**	920	350	280	220	>1600	1600	**828**
Fecal Coliform (MPN)	**1.8**	49.0	17.0	23.0	23.0	94.0	13.0	**36.5**
Al (mg/l)	**0.040**	ND	ND	ND	ND	ND	ND	**ND**
As (mg/l)	**0.0020**	ND	ND	ND	ND	ND	ND	**ND**
Ba (mg/l)	**0.0020**	0.040	0.078	0.020	0.011	0.077	0.074	**0.050**
B (mg/l)	**0.20**	ND	ND	ND	ND	ND	ND	**ND**
Cd (mg/l)	**0.00040**	ND	ND	ND	ND	ND	ND	**ND**
Cr (mg/l)	**0.0020**	ND	ND	ND	ND	ND	ND	**ND**
Cu (mg/l)	**0.0020**	ND	0.0027	ND	ND	ND	0.0028	**ND**
Fe (mg/l)	**0.20**	ND	ND	ND	ND	ND	ND	**ND**
Pb (mg/l)	**0.0010**	ND	ND	ND	ND	ND	ND	**ND**
Hg (mg/l)	**0.00020**	ND	ND	ND	ND	ND	ND	**ND**
Se (mg/l)	**0.0080**	ND	ND	ND	ND	ND	ND	**ND**
V (mg/l)	**0.0030**	0.0064	0.0060	0.0062	0.0064	0.0056	0.0051	**0.0060**
Zn (mg/l)	**0.020**	ND	ND	ND	ND	ND	ND	**ND**

NOTE: RL = Reporting Limit; ND = None Detected at RL; NA = Not Available; --- = Not Applicable.

III. FISH POPULATIONS

The study of fish populations in conjunction with water quality measurement is a particularly valuable component of a monitoring program for several reasons. Physical and chemical water parameters vary significantly between samplings; as a consequence, extreme conditions may not be recorded. Fish, however, are continuously exposed to variations in water quality and are indicators of the long-term "health" of a stream. Collection of fish population data over several years from different stations in the project area helps to identify places that support year-round breeding populations of both game and non-game species.

The Anderson Creek watershed is located in the Mayacmas Mountains of southwestern Lake County and forms a tributary to upper Putah Creek, which flows into Lake Berryessa. Thus, the Anderson Creek watershed is not accessible to anadromous salmonids such as steelhead (*Oncorhynchus mykiss*).

III.1 Methods

Fish monitoring was conducted during the month of July, as directed by Lake County agencies, because previous KGRA-ARM data (Karfiol and McMillan, 1983) were also collected in July and because that period was deemed late enough in the trout's reproductive season to estimate spawning success for the entire year (McKean *et al.*, 1998). Sampling procedures are those described in Karfiol and McMillan (1983) and Jordan *et al.* (1986) and are standard for fisheries research. The process involved the placement of blocking nets on the upstream and downstream ends of a 30-meter stretch of stream. Fish populations were surveyed using a standard multi-pass depletion method. Statistical population estimates were calculated using the Microfish 3.0 computer program (Van Deventer and Platts, 1988). Since the projected total population is an estimate, the number of fish actually captured may be lower. The statistical treatment of the data is necessary since it is not always possible to catch all fish in a particular reach of the stream. As a consequence, reporting only the number actually caught could underestimate the number of fish present in a given reach. It should be noted that riffle sculpins (*Cottus gulosus*) do not have swim bladders and thus typically remain on the bottom of the stream where they are difficult to capture. As such, population estimates for this species tend to be somewhat unreliable.

Rainbow trout were measured using fork length while the total length was used for California roach (*Lavinia symetricus*), Sacramento sucker (*Catostomus occidentalis*) and riffle sculpin. Age classes of rainbow trout were determined by correlating length of the captured fish with growth patterns described in Karfiol and McMillan (1983). Thus, individuals measuring less than 85 millimeters (mm) are categorized as young-of-the-year while those measuring 85 mm or greater are yearling-or-older. It should be noted, however, that using fixed size (i.e., 85 mm) to separate age classes is somewhat inaccurate as it does not account for site-specific or yearly differences in growth rates. For example, the bimodal size distribution evident at BeC-0.9 during prior sampling

events suggested that fish up to 95 mm were likely young-of-the-year fish at this particular site. However, age assessments using bimodal distributions are typically more reliable with larger sampling sizes and thus this method may at times prove inconclusive when few individuals are present or most individuals fall into only one size class. Given that the 85 mm age class cut-off has been used in BC/WFF sampling for the previous 31 years, this approach is retained for the 2020 results discussed below.

III.2 Results

BC/WFF fish surveys for the 2020 monitoring period were conducted on July 30 and 31. The locations of two long-term sampling sites (Gu-1.9 and BeC-0.9) had to be moved in 2019, as described in more detail below. Rainbow trout were captured at five of the six sampling stations. Rainbow trout have not been captured at CuC-0.1 since 2010. Riffle sculpins occurred at An-2.8, BeC-0.6, and CuC-0.1. In the past, California roach were only captured at BeC-0.9 and in 2020 this species was only present at the relocated site (BeC-0.6). Sacramento suckers, a species that is occasionally present in low numbers at stations An-2.8 and BeC-0.9 (see Table III.1), was not captured in 2020.

Table III.1 shows the population estimates for fish found at the six BC/WFF stations in July 2020 and summarizes population data for all previous sampling years. Table III.2 presents the numbers and percentages of young-of-the-year and yearling-and-older rainbow trout collected at all six BC/WFF stations in July 2020, as well as prior years. Fish length histograms for rainbow trout captured in 2020 are presented in Figure III.1, while Figure III.2 shows trends in total abundance and young-of-the-year abundance over the duration of the monitoring project.

An-2.8

The July 2020 rainbow trout population estimate was 70, slightly (17%) lower than the 2019 estimate of 84, but substantially higher than the long-term station average of 54 (Table III.1). The number of trout captured in July 2020 was 59, of which 39 individuals (66%) were young-of-the-year and 20 individuals (34%) were yearling-and-older. The 2000 estimate of 116 was the highest value for rainbow trout surveys conducted at this station since 1980. The lowest population estimate was 17 in 1991. The long-term average trout population estimate for this site is 54.

A total of 5 riffle sculpins were captured at An-2.8 in July 2020. The average sculpin population estimate for this site is 28. Estimates for this species have always fluctuated widely since the early 1980's (Table III.1), partially due to the difficultly inherent in sampling this species with standard electrofishing methods.

It should be noted that in 2018, a single bullfrog (*Lithobates catesbeianus*) larva was captured at Station An-2.8 in the lower Anderson Creek watershed. Bullfrogs are an introduced species and their large size, high mobility, generalized eating habits, and huge reproductive capabilities, have made them extremely successful invaders and a threat to Californian biodiversity. Bullfrogs have been linked to the decline of sensitive aquatic species such as California red-legged frogs (*Rana draytonii*) and are also known to feed on foothill yellow-legged frogs *(Rana boylii*) and juvenile trout. This is the first time that the authors of this report have observed a bullfrog in the Anderson

Creek watershed during twenty years of survey work. Due to the great threat this species poses to native aquatic species, the captured bullfrog larva was destroyed. No bullfrogs were observed in 2019 or 2020.

An-4.4

The rainbow trout population estimate for July 2020 was 26, a 225% increase over the 2019 estimate of 8 (Table III.1). Of the 23 individuals captured, 19 (83%) were young-of-the-year fish and 4 (17%) were yearling-and-older trout. This represents a modest improvement in over-wintering survival compared to 2019 when no yearling-or-older fish were encountered at this site. Population estimates at An-4.4 have ranged from 5 in 2008 to 76 in 1979, and the long-term average for this station is 35. After this site contained the lowest population estimate recorded since the inception of the BC/WFF monitoring program in 2008, the rainbow trout population rebounded drastically in 2009 and 2010, maintained an above-average size in 2011, but gradually declined over the past eight years. The 2020 population estimate appears to mark a positive reversal in this trend. Qualitatively, habitat availability within the sampling reach had decreased since 2011, with the lower half of the reach now consisting of a braided network of shallow channels, but a more distinct channel offering greater habitat availability was present in 2020.

Gu-0.5

The July 2020 population estimate for rainbow trout at Gu-0.5 was 41, a substantial increase (71%) over the 2019 estimate of 24, and comparable to the 2018 estimate of 44. Of the 35 trout captured, 15 (43%) were young-of-the-year fish, and 20 (57%) were yearling-and-older. After experiencing a slow but steady decline in yearly population estimates from 2011 through 2015 (Figure II.2), the trout population recovered to near-average numbers in 2016 and 2017, and exceeded the long-term average in 2018. However, the 2019 estimate was the lowest recorded at this site since 2015. The lowest population estimate ever recorded at Gu-0.5 was 12 in 2014, and the highest recorded estimate of 69 occurred in 1979. The long-term average for this site is 34.

Gu-2.4

As a result of changed conditions at Station Gu-1.9 related to the 2015 Valley Fire, particularly the high number of felled Douglas fir trees within the creek bed, this site was inaccessible for fish sampling in 2018. In addition, a visual survey of the site in 2018 revealed no fish, suggesting that this site may no longer support rainbow trout. Due to these conditions, the fish survey reach was relocated in July 2019 from Gu-1.9 to the associated long-term water quality sampling site Gu-2.4, located a short distance upstream. A culverted stream crossing is located between sampling sites Gu-1.9 and Gu-2.4, but this culvert appears passable to fish under some hydraulic conditions. Gu-2.4 is characterized by slightly steeper channel topography than Gu-1.9, and the boulder-dominated step-run habitats present more challenging conditions for trout than the riffle-pool habitat sequences that were prevalent at Gu-1.9. Therefore, fish survey results at Gu-2.4 may not be directly comparable to past population estimates at Gu-1.9.

In July 2020, the rainbow trout population estimate for Gu-2.4 was 11, a meaningful increase over the 2019 estimate of 2. Of the 11 trout captured, all (100%) were young-of-the-year fish. In 2016, the first year of sampling following the 2015 Valley Fire, only two trout were captured at Gu-1.9. In 2017, no rainbow trout were captured at Gu-1.9, and a 2018 visual survey of

approximately 300 ft of channel upstream of the sampling site did not reveal any fish either. These recent data appeared to indicate that the fish population in this reach of Gunning Creek had become extirpated in the aftermath of the 2015 Valley Fire. Moreover, the California Fish Passage Assessment Database (PAD) identifies a natural partial fish passage barrier ("Gunning Creek Falls") located approximately 1,200 ft downstream of Gu-1.9 (and approximately 3,700 ft upstream of Gu-0.5). Although characterized as a "partial" barrier (i.e., fish passage may be possible during some hydraulic conditions) these falls may prevent natural reintroduction of trout into upper Gunning Creek and Gu-1.9 in the future. The presence of two trout at the relocated sampling site in July 2019 suggest that a remnant population of rainbow trout remained in upper Gunning Creek, and the presence of 11 young-of-the-year trout in 2020 provides an encouraging sign that this stream reach is gradually being repopulated.

BeC-0.6

During the 2018-2019 high flow season, a large, deep pool that used to comprise the majority of historic sampling site BeC-0.9 had become filled with sediment and/or its downstream hydraulic control had been scoured out, leaving minimal, shallow aquatic habitat in its place. Sampling in these significantly altered geomorphic condition would have rendered comparisons to past fish surveys misleading and therefore inappropriate. The sampling site was therefore relocated approximately 0.3 kilometers (1,000 ft) downstream to a new sampling site (BeC-0.6) for the July 2019 surveys. Sampling site BeC-0.6 was selected because it contains habitat features (e.g., large pool) that approximate past conditions at BeC-0.9. However, trout population estimates at BeC-0.9 and BeC-0.6 are likely not directly comparable, as indicated below.

The July 2020 rainbow trout population estimate for BeC-0.6 was 24, an 81% decrease from the 2019 estimate of 124, which represented the largest estimate ever recorded in Bear Canyon Creek (Table III.1). Of the 20 trout caught at BeC-0.6 in 2020, 18 (90%) were young-of-the-year and only 2 (10%) were yearling-and-older fish. This age class distribution is almost identical to those observed at BeC-0.9 in 2018 and BeC-0.6 in 2019 (Table III.2), suggesting high spawning success in Bear Canyon Creek in 2018 through 2020. In past sampling years, population estimates at BeC-0.9 have exhibited large variations, ranging from 7 in 1982 to 110 in 1999, with a long-term average population estimate of 38. The likely cause of these large variations in population size is habitat variation. The majority of the BeC-0.9 sampling reach consisted of one large pool that underwent cycles of scouring and deposition, resulting in considerable variation in habitat quantity and quality within this reach. In 2020, BeC-0.6 presented similar habitat conditions with one long, deep glide/pool. Low baseflows during drought conditions (e.g., 2014 and 2015) also affected the low-gradient BeC-0.9 site where water temperatures were typically higher than at other sampling sites located in the upper watershed (e.g., An-4.4 and Gu-1.9). The predominance of California roach at BeC-0.6 in 2020 (see below) suggests similar conditions.

The July 2020 population estimate for riffle sculpin was 68, substantially (90%) lower than the 2019 estimate of 68 and reflective of reduction in fast-water riffle habitat at BeC-0.6 compared to 2019. Nevertheless, population estimates for riffle sculpins vary significantly in Bear Canyon Creek from year to year (Table III.1), partially due to the difficultly inherent in sampling this species with standard electrofishing methods. In previous years, the estimates at BeC-0.9 ranged from 7 in 1995 to 101 in 1975 with a long-term station average of 27.

California roach were not observed at BeC-0.6 in 2019, but were the dominant species in 2020 with a population estimate of 84. California roach, a native species adapted to slow, warm water and large pools, were regularly present at BeC-0.9, frequently undergoing large population fluctuations (Table III.1), ranging from none caught in 1988 and 1996 to 128 in 1994. The long-term average population estimate at this site was 17. The new BeC-0.6 sampling provided less favorable roach habitat than BeC-0.9 in 2019, but 2020 conditions were more similar to those historically observed at BeC-0.9.

No Sacramento suckers were captured at BeC-0.6 in July 2020. The species had been present at BeC-0.9 in low numbers from 2008 through 2010 after its absence from that site since 1992 (Table III.1).

CuC-0.1

No rainbow trout or riffle sculpins were captured at CuC-0.1 in July 2020. One single trout was present at this site in 2009 and 2010. At the time, we speculated that the same fish may have been captured in both years, based on length measurements, and that no immigration to this bedrock-dominated reach with limited habitat had occurred during those two years (ESA, 2011). The average for this site is 8 (after nine years with no trout) and previous population estimates ranged from 0 in 2004 to 55 in 1999.

The primary substrate type at this sampling location is bedrock and geomorphologic changes over the past years have resulted in marginal trout habitat. Water depths in July are typically less than one inch in most places, the width of the wetted channel averages about 3 to 6 inches, and the depths in the two primary pools that used to support trout during the summer low-flow period have decreased considerably. Furthermore, the only portion of the survey reach containing spawning-size gravels may be too small to support rainbow trout spawning activities. It should be noted, however, that foothill yellow-legged frogs (*Rana boylii*), rough-skinned newts (*Taricha granulosa*), and California giant salamander (*Dicamptodon ensatus*) larvae are regularly observed at this sampling site, indicative of the high-quality aquatic habitat for native amphibians in Cub Canyon Creek.

III.3 DISCUSSION

During the course of a year many factors may induce population fluctuations, such as changes in water quality and flow, passage of natural barriers by trout, habitat availability, spawning success, production of food (benthic macroinvertebrates) and influx of foreign materials or sediments. Direct cause and effect relationships are difficult to establish since fish populations, even in an undisturbed area, can fluctuate due to natural variations in either the biotic or abiotic components of the ecosystem.

Compared to 2019, the 2020 rainbow trout population estimates increased at three sampling sites, decreased at two sites, and remained constant at one site. The population estimates increased markedly at one long-term sampling sites (An-4.4) and one relocated site (Gu-2.4), both located in the upper watershed. The largest decrease in the trout population estimate occurred at BeC-0.6, but California roach were abundant at this site in 2020, suggesting that lower baseflows in this

low-gradient, open stream reach may have resulted in stressful conditions for cold-water trout and more suitable conditions for warm-water roach. CuC-0.1 contained no trout for the tenth consecutive year.

As discussed in previous annual summary reports, historic BC/WFF fish survey data suggest that the timing of high flow events plays a far more significant role in young-of-the year abundances (and therefore subsequent yearling-and-older abundances) than the overall water year type (e.g., wet versus dry year). With the occurrence of the September 2015 Valley Fire, an additional variable has been added to the analysis of fish population trends. However, a comparison of pre-fire (2015) to post-fire (2016) population data did not reveal any clear trends, possibly because long-term drought-related effects may have confounded these trends (ESA, 2017). In fact, the overall trout abundance (i.e., the total of all sampling site population estimates) increased by 27% from 2015 to 2016, and length-frequency analysis of the fish data indicated that large fish (i.e., yearling-and-older) were more common in 2016 than 2015, suggesting a relatively high year-over-year survival rate (ESA, 2017).

Subsequently, overall trout abundance estimates declined in 2018 to the lowest ever recorded (111 individuals) since the inception of the BC/WFF program and remained very low (118 individuals) in 2019. For 2020, the abundance estimate has increased to 148 individuals, but remains below the long-term average of 180.

The 2020 population estimates at An-2.8 and Gu-0.5 were among the highest ever recorded in their respective stream reaches, but declined by an estimated 100 fish at BeC-0.6 compared to 2019. As discussed above, habitat changes from riffle-and-pool habitat in 2019 to one long, deep glide/pool with low water velocities and qualitatively warm water temperature likely decreased suitability for rainbow trout while increasing the suitability for the California roach that dominated the site in 2020. However, given the drastic decline in the trout population at Bec-0.6 in 2020 and the continued absence of trout at CuC-0.1, the increase in total abundance for all BC/WFF sites is all the more remarkable. Changing year-over-year instream habitat conditions demonstrate that areas streams are still rebounding from the effects of the 2015 Valley Fire; however, the overall health of the fishery remains robust.

TABLE III.1

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
An-2.8	1980	77	0	0	81
	1983	20	0	1	36
	1988	31	0	0	32
	1989	25	0	0	10
	1990	25	0	0	19
	1991	17	0	0	14
	1992	34	0	0	30
	1993	18	0	0	36
	1994	44	0	0	28
	1995	27	0	0	17
	1996	27	0	0	12
	1997	70	0	0	24
	1998	37	0	0	28
	1999	92	0	0	12
	2000	116	0	0	42
	2001	78	0	0	39
	2002	30	0	0	15
	2003	42	0	0	17
	2004	40	0	0	33
	2005	46	0	0	37
	2006	46	0	0	16
	2007	39	0	0	12
	2008	46	0	0	17
	2009	55	0	0	24
	2010	79	0	0	16
	2011	101	0	0	28
	2012	58	0	0	16
	2013	60	0	0	35
	2014	74	0	0	15
	2015	44	0	0	42
	2016	91	0	0	88
	2017	88	0	0	44
	2018	48	0	0	28
	2019	84	0	0	44
	2020	70	0	0	5
	Average	***54***	***0***	***0***	***28***
An-4.4	1975	33	0	0	0
	1978	18	0	0	0
	1979	76	0	0	0
	1980	64	0	0	0
	1982	13	0	0	0
	1983	19	0	0	0

TABLE III.1 (CONTINUED)

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
An-4.4	1988	28	0	0	0
(Cont.)	1989	30	0	0	0
	1990	41	0	0	0
	1991	35	0	0	0
	1992	32	0	0	0
	1993	35	0	0	0
	1994	67	0	0	0
	1995	27	0	0	0
	1996	31	0	0	0
	1997	53	0	0	0
	1998	27	0	0	0
	1999	64	0	0	0
	2000	53	0	0	0
	2001	47	0	0	0
	2002	39	0	0	0
	2003	32	0	0	0
	2004	42	0	0	0
	2005	46	0	0	0
	2006	29	0	0	0
	2007	58	0	0	0
	2008	5	0	0	0
	2009	18	0	0	0
	2010	44	0	0	0
	2011	41	0	0	0
	2012	30	0	0	0
	2013	27	0	0	0
	2014	24	0	0	0
	2015	23	0	0	0
	2016	15	0	0	0
	2017	32	0	0	0
	2018	19	0	0	0
	2019	8	0	0	0
	2020	26	0	0	0
	Average	***35***	***0***	***0***	***0***
Gu-0.5	1975	53	0	0	0
	1979	69	0	0	0
	1982	24	0	0	0
	1983	28	0	0	0
	1988	21	0	0	0
	1989	17	0	0	0
	1990	30	0	0	0
	1991	33	0	0	0

TABLE III.1 (CONTINUED)

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
Gu-0.5	1992	16	0	0	0
(Cont.)	1993	20	0	0	0
	1994	40	0	0	0
	1995	13	0	0	0
	1996	23	0	0	0
	1997	46	0	0	0
	1998	33	0	0	0
	1999	50	0	0	0
	2000	68	0	0	0
	2001	23	0	0	0
	2002	28	0	0	0
	2003	47	0	0	0
	2004	41	0	0	0
	2005	41	0	0	0
	2006	39	0	0	0
	2007	30	0	0	0
	2008	28	0	0	0
	2009	23	0	0	0
	2010	41	0	0	0
	2011	51	0	0	0
	2012	35	0	0	0
	2013	28	0	0	0
	2014	12	0	0	0
	2015	17	0	0	0
	2016	36	0	0	0
	2017	31	0	0	0
	2018	44	0	0	0
	2019	24	0	0	0
	2020	41	0	0	0
	Average	***34***	***0***	***0***	***0***
Gu-1.9	1975	25	0	0	0
	1978	40	0	0	0
	1979	24	0	0	0
	1982	16	0	0	0
	1983	15	0	0	0
	1988	44	0	0	0
	1989	26	0	0	0
	1990	34	0	0	0
	1991	36	0	0	0
	1992	22	0	0	0
	1993	36	0	0	0
	1994	38	0	0	0

TABLE III.1 (CONTINUED)

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
Gu-1.9	1995	18	0	0	0
(Cont.)	1996	37	0	0	0
	1997	34	0	0	0
	1998	40	0	0	0
	1999	47	0	0	0
	2000	29	0	0	0
	2001	13	0	0	0
	2002	26	0	0	0
	2003	35	0	0	0
	2004	52	0	0	0
	2005	44	0	0	0
	2006	31	0	0	0
	2007	29	0	0	0
	2008	24	0	0	0
	2009	21	0	0	0
	2010	40	0	0	0
	2011	29	0	0	0
	2012	24	0	0	0
	2013	28	0	0	0
	2014	17	0	0	0
	2015	13	0	0	0
	2016	2	0	0	0
	2017	0	0	0	0
	2018	NA	NA	NA	NA
Gu-2.4	2019	2	0	0	0
	2020	11			
	Average	***26***	***0***	***0***	***0***
BeC-0.9	1975	51	5	0	101
	1979	60	43	12	51
	1980	35	34	0	19
	1982	7	6	0	30
	1983	33	2	0	13
	1988	15	0	0	13
	1989	57	9	2	31
	1990	18	8	0	20
	1991	9	19	0	37
	1992	18	36	1	34
	1993	12	4	0	42
	1994	28	128	0	41
	1995	23	2	0	7
	1996	32	0	0	8
	1997	53	37	0	13

TABLE III.1 (CONTINUED)

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
BeC-0.9	1998	62	4	0	34
(Cont.)	1999	110	19	0	31
	2000	54	8	0	20
	2001	58	8	0	17
	2002	17	24	0	33
	2003	17	15	0	22
	2004	10	9	0	13
	2005	22	6	0	22
	2006	22	9	0	10
	2007	37	5	0	14
	2008	55	14	3	39
	2009	27	9	1	14
	2010	10	14	1	7
	2011	59	7	0	36
	2012	30	4	0	13
	2013	N/A	N/A	N/A	N/A
	2014	29	2	0	20
	2015	16	2	0	26
	2016	56	17	0	25
	2017	60	28	0	35
	2018	68	76	0	27
BeC-0.6	2019	124	0	0	68
	2020	24	84	0	9
	Average	***38***	***18***	***1***	***27***
CuC-0.1	1975	6	0	0	0
	1979	7	0	0	0
	1982	6	0	0	0
	1983	3	0	0	0
	1988	2	0	0	0
	1989	5	0	0	0
	1990	8	0	0	0
	1991	25	0	0	0
	1992	31	0	0	0
	1993	45	0	0	0
	1994	19	0	0	0
	1995	5	0	0	0
	1996	12	0	0	0
	1997	22	0	0	0
	1998	14	0	0	0
	1999	55	0	0	0
	2000	10	0	0	0
	2001	13	0	0	0

TABLE III.1 (CONTINUED)

SUMMARY OF YEARLY FISH POPULATION ESTIMATES

Station	Year	Rainbow Trout	California Roach	Sacramento Sucker	Riffle Sculpin
CuC-0.1	2002	2	0	0	0
(Cont.)	2003	1	0	0	0
	2004	0	0	0	0
	2005	2	0	0	0
	2006	3	0	0	0
	2007	10	0	0	0
	2008	4	0	0	0
	2009	1	0	0	2
	2010	1	0	0	0
	2011	0	0	0	0
	2012	0	0	0	0
	2013	0	0	0	0
	2014	0	0	0	0
	2015	0	0	0	0
	2016	0	0	0	6
	2017	0	0	0	1
	2018	0	0	0	6
	2019	0	0	0	2
	2020	0	0	0	0
	Average	***8***	***0***	***0***	***0***

NOTE: Data presented for dates prior to 1998 are adapted from McKean *et al.* (1998).

TABLE III.2

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
An-2.8	1980	70	92	6	8
	1983	14	70	6	30
	1988	23	79	6	21
	1989	19	76	6	24
	1990	16	64	9	36
	1991	10	63	6	37
	1992	24	75	8	25
	1993	9	60	6	40
	1994	8	20	33	80
	1995	21	78	6	22
	1996	18	67	9	33
	1997	61	94	4	6
	1998	26	72	10	28
	1999	59	84	11	16
	2000	79	89	10	11
	2001	60	83	12	17
	2002	19	70	8	30
	2003	35	83	7	17
	2004	28	72	11	28
	2005	26	65	14	35
	2006	34	74	12	26
	2007	24	65	13	35
	2008	39	85	7	15
	2009	45	90	5	10
	2010	56	80	14	20
	2011	57	69	26	31
	2012	31	55	25	45
	2013	46	81	11	19
	2014	51	76	16	24
	2015	34	79	9	21
	2016	61	80	15	20
	2017	51	77	15	23
	2018	36	77	11	23
	2019	66	87	10	13
	2020	39	66	20	34
An-4.4	1983	13	68	6	32
	1988	13	46	15	54
	1989	15	50	15	50
	1990	25	61	16	39
	1991	24	68	11	32
	1992	24	75	8	25
	1993	16	47	18	53

TABLE III.2 (CONTINUED)

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
An-4.4	1994	39	68	18	32
(Cont.)	1995	3	14	18	86
	1996	12	40	18	60
	1997	41	80	10	20
	1998	12	46	14	54
	1999	48	79	13	21
	2000	34	69	15	31
	2001	28	61	18	39
	2002	20	57	15	43
	2003	16	50	16	50
	2004	19	53	17	47
	2005	22	50	22	50
	2006	14	48	15	52
	2007	35	64	20	36
	2008	0	0	5	100
	2009	14	78	4	22
	2010	21	49	22	51
	2011	27	73	10	29
	2012	16	53	14	47
	2013	21	78	6	22
	2014	0	0	22	100
	2015	15	65	8	35
	2016	7	50	7	50
	2017	27	93	2	7
	2018	2	11	17	89
	2019	8	100	0	0
	2020	19	83	4	17
Gu-0.5	1983	11	44	14	56
	1988	14	70	6	30
	1989	5	29	12	71
	1990	19	67	11	33
	1991	12	36	21	64
	1992	10	62	6	38
	1993	8	44	10	56
	1994	17	45	21	55
	1995	5	38	8	62
	1996	13	57	10	43
	1997	25	66	13	34
	1998	18	64	10	36
	1999	28	62	17	38
	2000	31	62	19	38
	2001	6	26	17	74

TABLE III.2 (CONTINUED)

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
Gu-0.5	2002	12	50	12	50
(Cont.)	2003	24	53	21	47
	2004	25	64	14	36
	2005	24	60	16	40
	2006	21	55	17	45
	2007	14	48	15	52
	2008	15	63	9	37
	2009	11	48	12	52
	2010	27	66	14	34
	2011	31	65	17	35
	2012	15	44	19	56
	2013	22	79	6	21
	2014	1	8	11	92
	2015	10	59	7	41
	2016	18	60	12	40
	2017	22	76	7	24
	2018	21	51	20	49
	2019	11	58	8	42
	2020	15	43	20	57
Gu-1.9	1983	7	50	7	50
	1988	23	53	20	47
	1989	3	15	17	85
	1990	17	50	17	50
	1991	22	63	13	37
	1992	4	18	18	82
	1993	22	63	13	37
	1994	25	66	13	34
	1995	4	22	14	78
	1996	22	63	13	37
	1997	17	52	16	48
	1998	15	52	14	48
	1999	31	71	13	29
	2000	22	76	7	24
	2001	2	17	10	83
	2002	21	81	5	19
	2003	21	66	11	34
	2004	31	63	18	37
	2005	23	54	20	46
	2006	16	53	14	47
	2007	20	69	9	31
	2008	14	61	9	39
	2009	10	48	11	52

TABLE III.2 (CONTINUED)

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
Gu-1.9	2010	22	58	16	42
(Cont.)	2011	12	44	15	56
	2012	8	35	15	65
	2013	16	70	7	30
	2014	7	41	10	59
	2015	11	85	2	15
	2016	0	0	2	100
	2017	0	0	0	0
	2018	NA	NA	NA	NA
Gu-2.4	2019	1	50	1	50
	2020	11	100	0	0
BeC-0.9	1975	42	91	4	9
	1979	42	74	15	26
	1980	34	97	1	3
	1982	2	29	5	71
	1983	28	90	3	10
	1988	14	93	1	7
	1989	39	78	11	22
	1990	13	72	5	28
	1991	24	100	0	0
	1992	14	78	4	22
	1993	6	55	5	45
	1994	11	50	11	50
	1995	19	90	2	10
	1996	21	68	10	32
	1997	39	85	7	15
	1998	50	85	9	15
	1999	75	79	20	21
	2000	40	80	10	20
	2001	44	81	10	19
	2002	14	82	3	18
	2003	8	53	7	47
	2004	6	60	4	40
	2005	18	82	4	18
	2006	10	50	10	50
	2007	20	57	15	43
	2008	35	83	7	17
	2009	18	72	7	28
	2010	5	50	5	50
	2011	43	83	9	17
	2012	15	58	11	42
	2013	N/A	N/A	N/A	N/A

TABLE III.2 (CONTINUED)

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
BeC-0.9	2014	18	72	7	28
(Cont.)	2015	9	56	7	44
	2016	10	25	30	75
	2017	33	70	14	30
	2018	59	94	4	6
BeC-0.6	2019	96	97	3	3
	2020	18	90	2	10
CuC-0.1	1975	0	0	6	100
	1979	0	0	7	100
	1982	0	0	6	100
	1983	0	0	3	100
	1988	0	0	2	100
	1989	4	80	1	20
	1990	6	87	2	13
	1991	21	84	4	16
	1992	29	94	2	6
	1993	40	89	5	11
	1994	9	47	10	53
	1995	0	0	5	100
	1996	11	92	1	8
	1997	22	100	0	0
	1998	10	71	4	29
	1999	43	78	12	22
	2000	4	40	6	60
	2001	8	62	5	38
	2002	0	0	2	100
	2003	1	100	0	0
	2004	0	0	0	0
	2005	2	100	0	0
	2006	0	0	3	100
	2007	7	70	3	30
	2008	0	0	4	100
	2009	0	0	1	100
	2010	0	0	1	100
	2011	0	0	0	0
	2012	0	0	0	0
	2013	0	0	0	0
	2014	0	0	0	0
	2015	0	0	0	0
	2016	0	0	0	0
	2017	0	0	0	0

TABLE III.2 (CONTINUED)

SUMMARY OF YEARLY AGE CLASS DISTRIBUTION OF RAINBOW TROUT

Station	Date	Young-of-the-Year	%	Yearling-and-Older	%
CuC-0.1	2018	0	0	0	0
(Cont.)	2019	0	0	0	0
	2020	0	0	0	0

NOTE: Data presented for dates prior to 1998 are adapted from McKean *et al.* (1998).

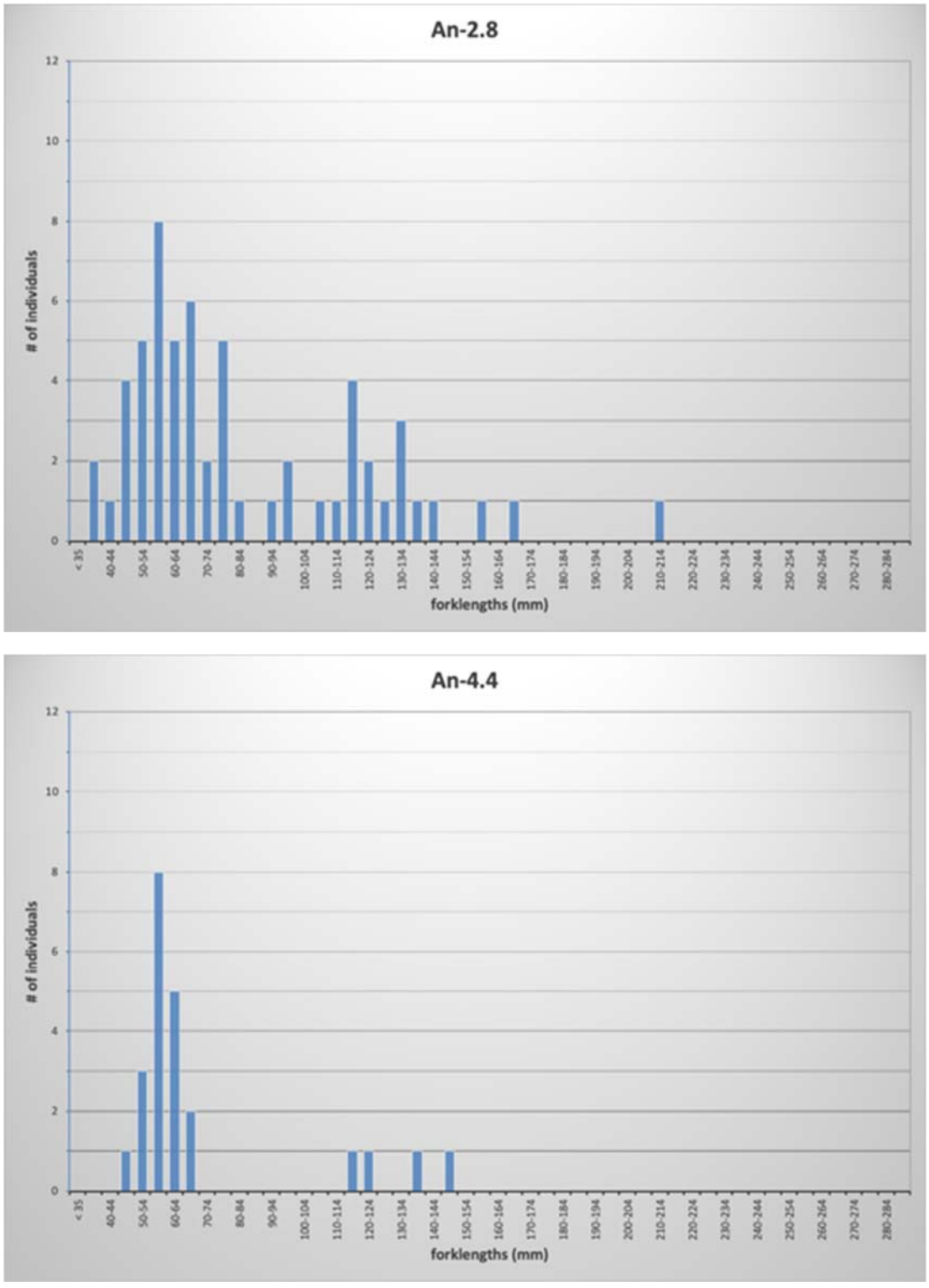


Figure III-1. Size Distributions of Rainbow Trout, July 2020

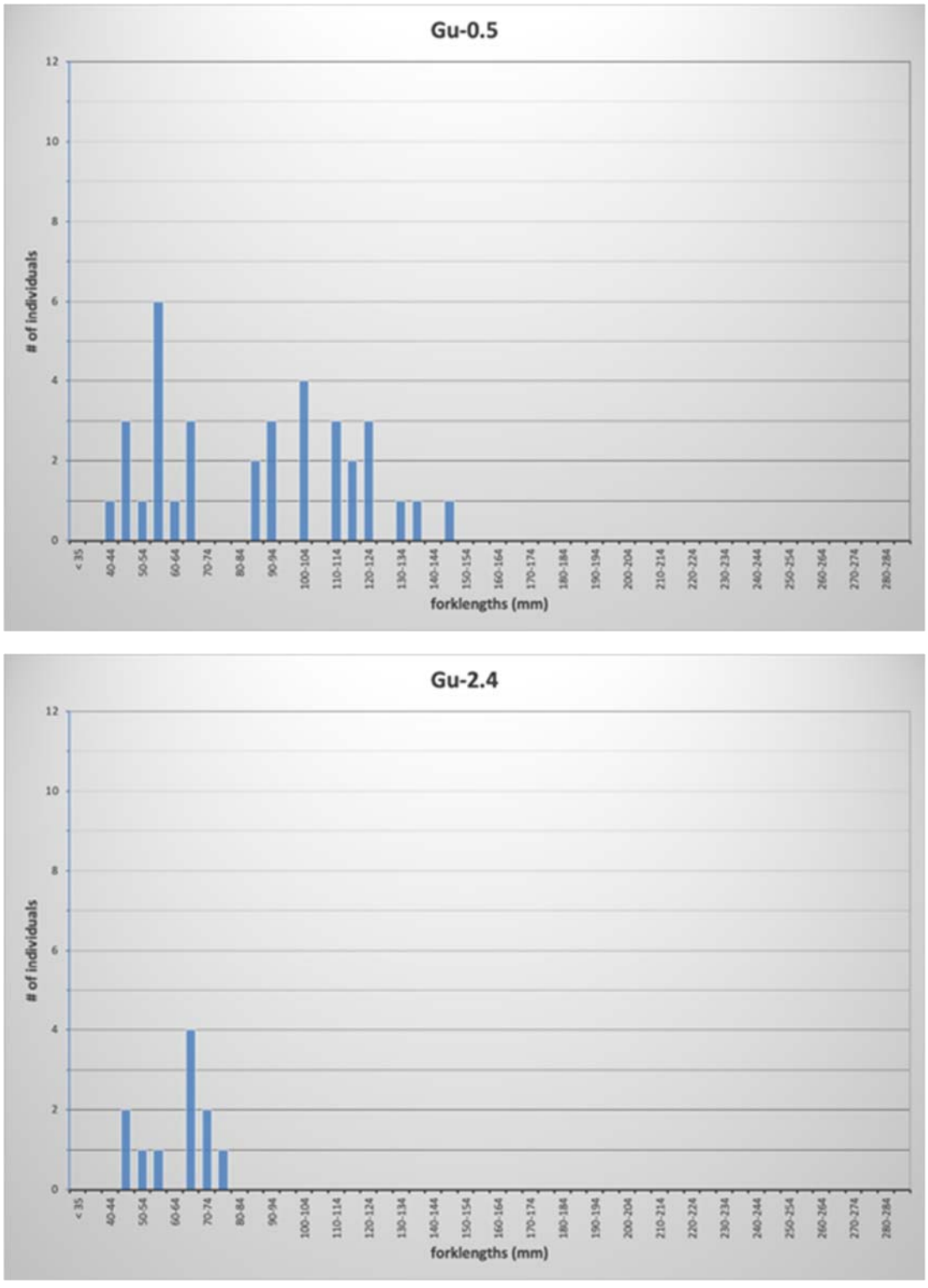


Figure III-1. Size Distributions of Rainbow Trout, July 2020 (continued)

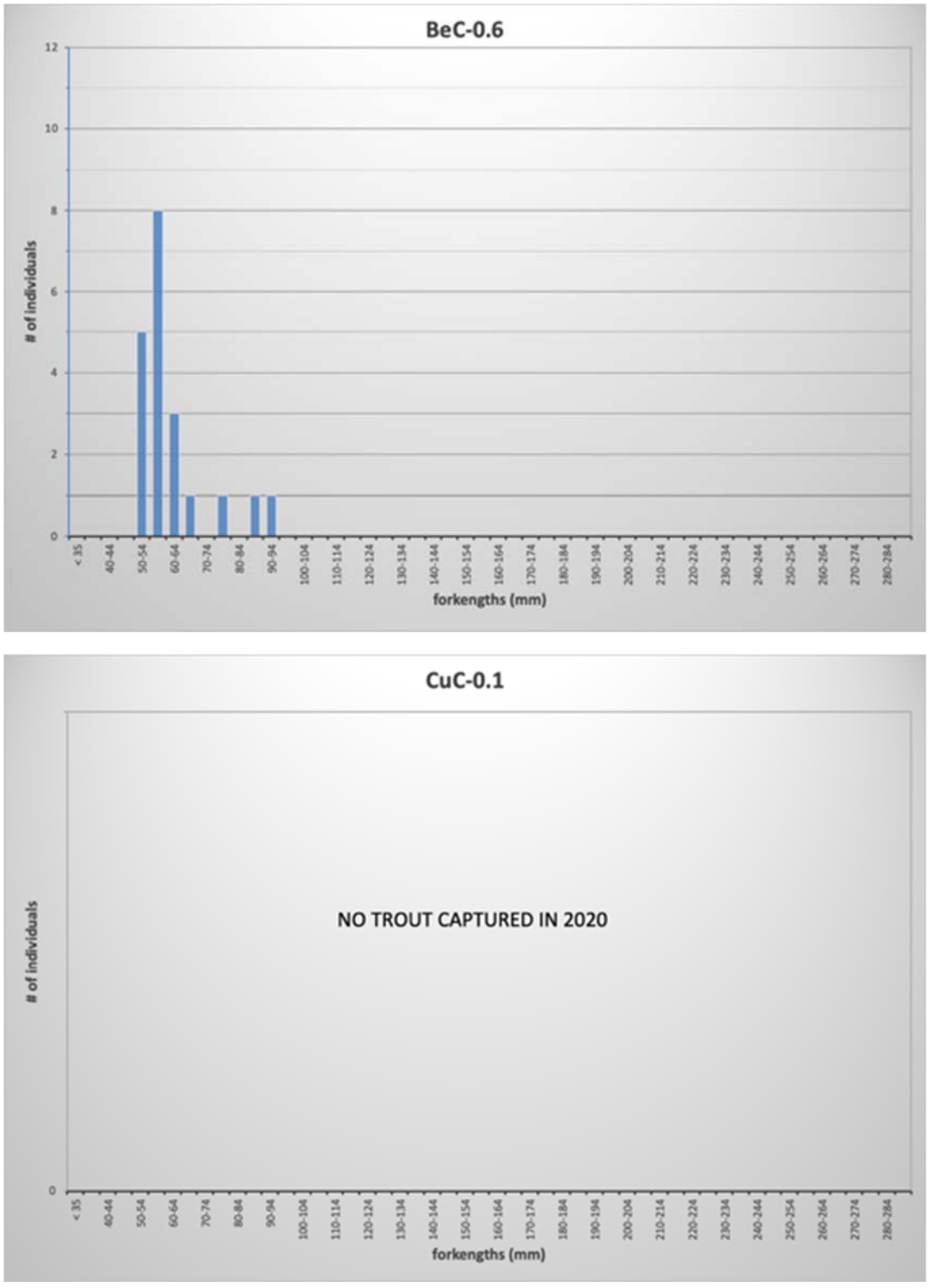
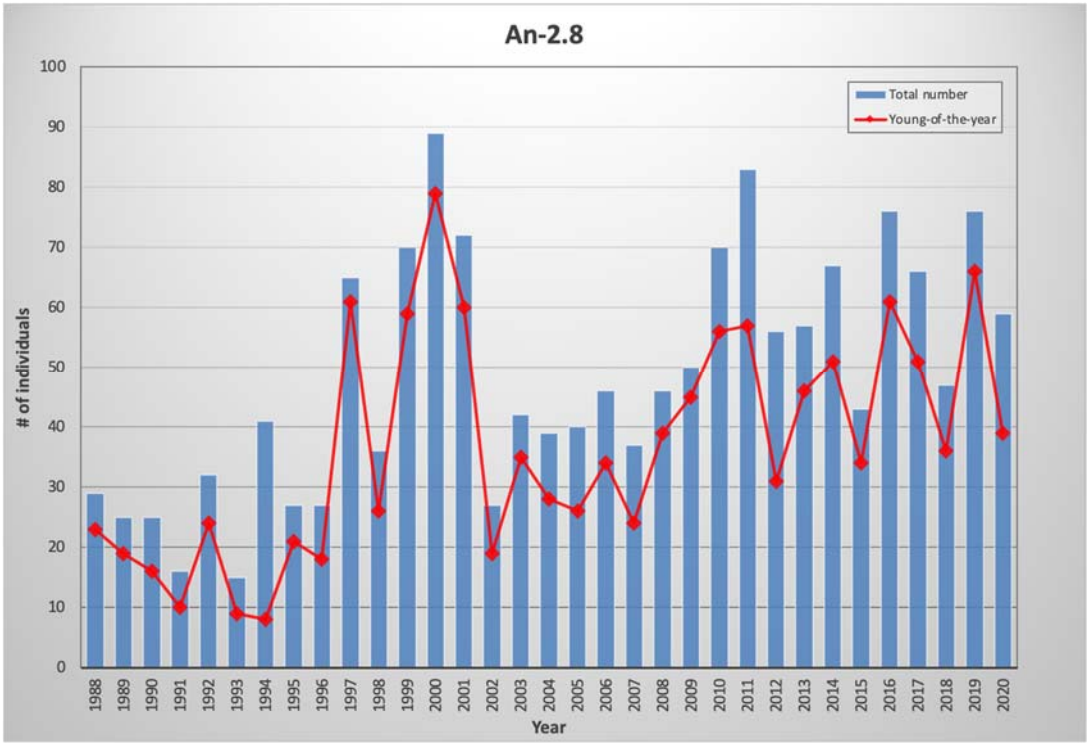


Figure III-1. Size Distributions of Rainbow Trout, July 2020 (continued)



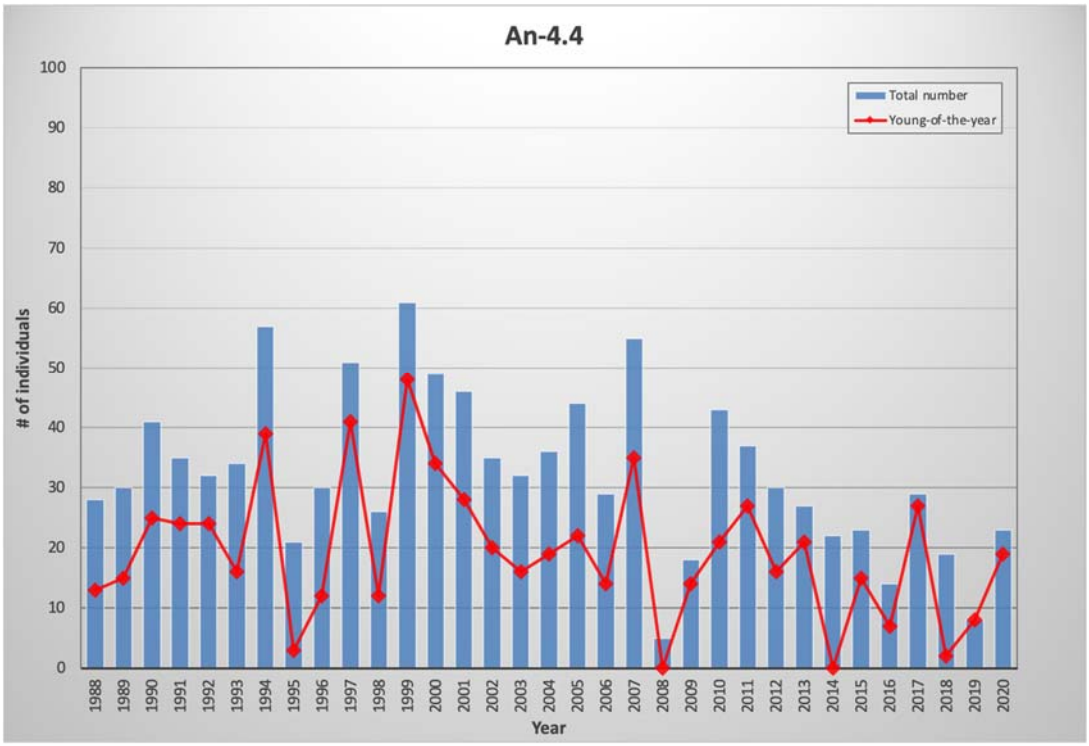


Figure III-2. Summary of Yearly Age Class Distributions of Rainbow Trout, July 2020

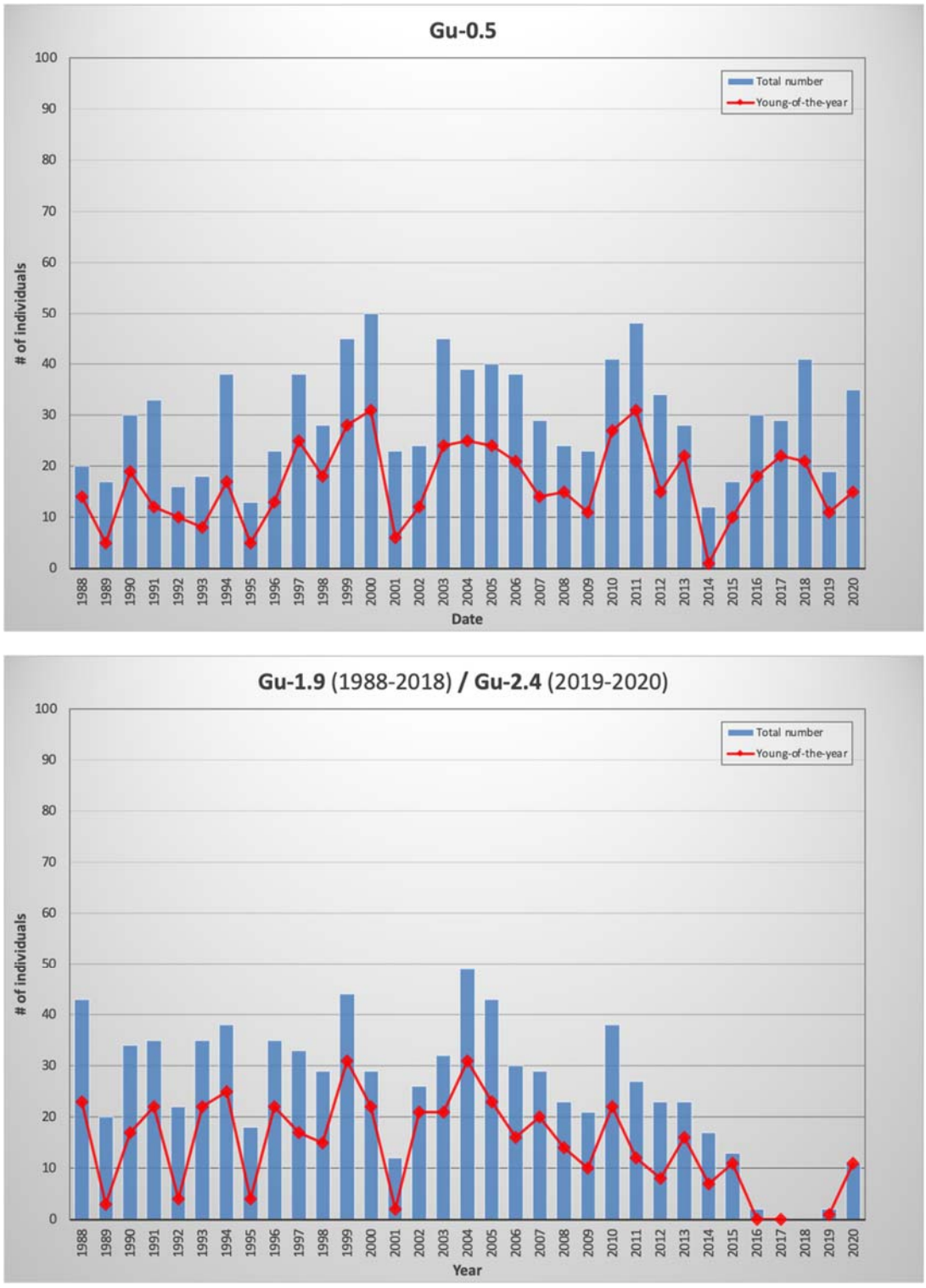
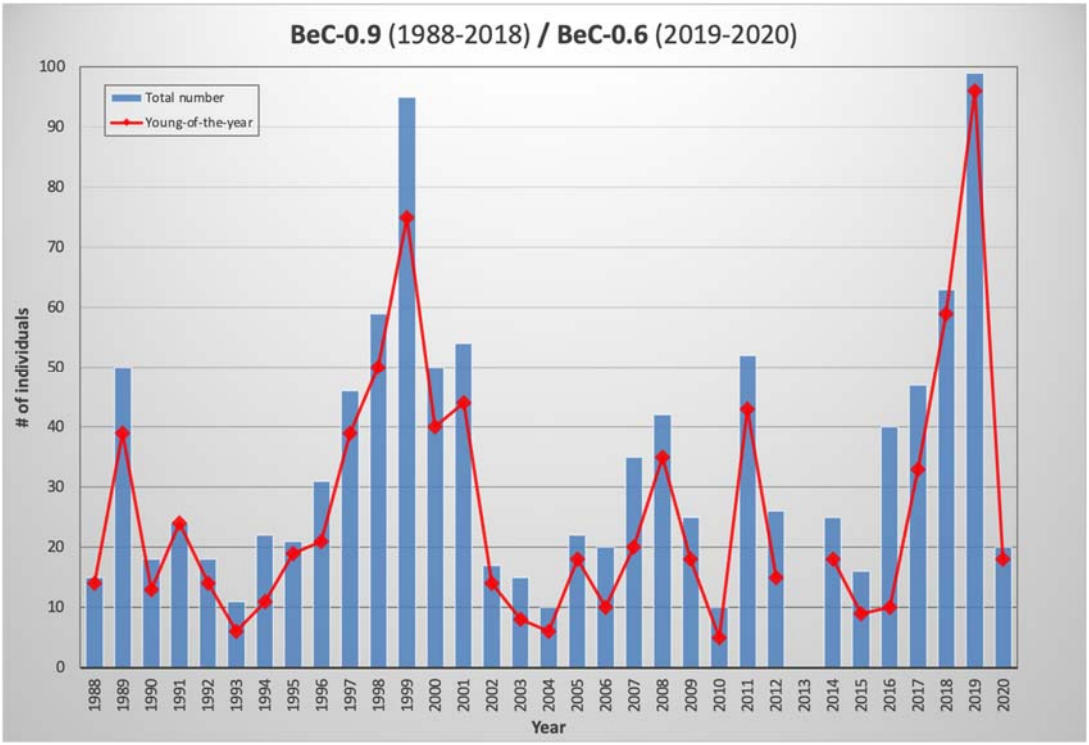
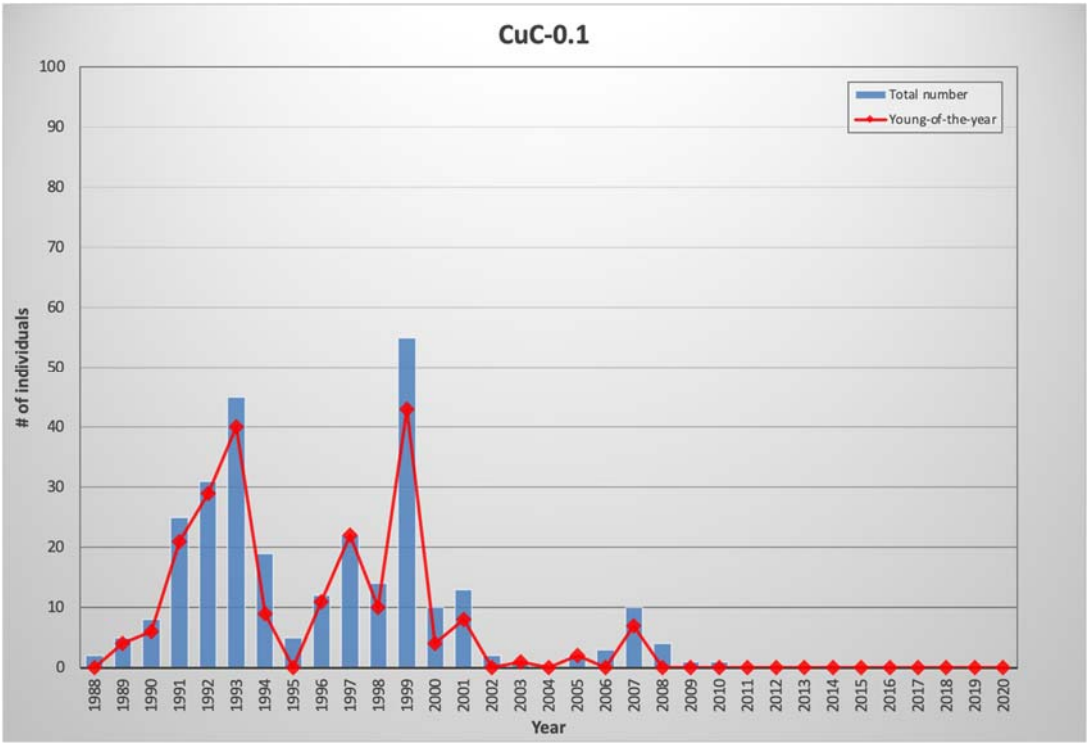


Figure III-2. Summary of Yearly Age Class Distributions of Rainbow Trout, July 2020 (cont.)





NOTE: Data presented for dates prior to 1998 are adapted from McKean *et al.* (1998).

Figure III-2. Summary of Yearly Age Class Distributions of Rainbow Trout, July 2020 (cont.)

IV. REFERENCES

American Public Health Association (APHA). 1995. Standard Methods for the Examination of Water and Wastewater. 19th Edition, American Public Health Association, Publication Office, Washington, DC.

American Public Health Association (APHA). 1985. Standard Methods for the Examination of Water and Wastewater. 16th Edition, American Public Health Association, Washington, DC, 1268 p.

Borgias, A. P. 1982. The acid solubility of arsenic in cooling tower sludge from the Geysers power plant. Research Report 420-82.82. Department of Engineering Research, Pacific Gas and Electric Company.

Brown and Caldwell Consulting. 1985. Postoperative Environmental Monitoring Summary Report. Published by Brown and Caldwell Consulting Engineers for Santa Fe Geothermal, Middletown.

California State Department of Health Services (CSDOH). 1977. California domestic water quality and monitoring regulations. TITLE 22, California Administrative Code.

Regional Water Quality Control Board (RWQCB). 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board Central Valley Region. Fourth Edition. The Sacramento River Basin and the San Joaquin River Basin.

Davis, E. A., K. J. Maier and A. W. Knight. 1988. The biological consequences of selenium in aquatic ecosystems. California Agriculture Jan-Feb: 18-20 & 29.

Eckblad, J. W. 1978. Aquatic Biology. Wm. C. Brown Company, Dubuque, Iowa, 231 p.

Environmental Science Associates (ESA). 2001. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 1999-2000 (BC/WFF XII). Prepared for Calpine Corporation.

Environmental Science Associates (ESA). 2002. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 2000-2001 (BC/WFF XIII). Prepared for Calpine Corporation.

Environmental Science Associates (ESA). 2010. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 2009-2010 (BC/WFF XXII). Prepared for Calpine Corporation.

Environmental Science Associates (ESA). 2011. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 2010-2011 (BC/WFF XXIII). Prepared for Calpine Corporation.

Environmental Science Associates (ESA). 2013. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 2012-2013 (BC/WFF XXV). Prepared for Calpine Corporation.

Environmental Science Associates (ESA). 2017. Bear Canyon and West Ford Flat Aquatic Monitoring Program Annual Report 2015-2016 (BC/WFF XXVIII & XXIX). Prepared for Calpine Corporation.

Hach. 1983. Water Analysis Handbook. Hach Company, Loveland, Colorado, Fascicle 1:1-22.

Hibbard, P. L. 1935. The significance of mineral matter in water. Journal of the American Water Works Association 21:884-896.

Ireland, R. R. and J. L. Carter. 1980. Chemical ecology investigations at the Geysers, California. Transactions of the Geothermal Resources Council 4:675-678.

Jordan, W. P., R. J. Brown and G. L. Stevens. 1986. Squaw Creek Aquatic Monitoring Program (SCAMP) Annual Report 1984-1985. Published by the Institute of Chemical Biology (USF) for GEO Operator Corporation, Santa Rosa.

Jordan, W. P., R. J. Brown, G. L. Stevens and K. D. Ward. 1987. Squaw Creek Aquatic Monitoring Program (SCAMP) Annual Report 1985-1986. Published by the Institute of Chemical Biology (USF) for GEOOC, Santa Rosa, and CCPA, Sacramento.

Jordan, W. P., R. J. Brown, K. D. Ward Jennings. 1988. Squaw Creek Aquatic Monitoring Program (SCAMP) Annual Report 1986-1987 and Three-year Summary. Published by the Institute of Chemical Biology (USF) for GEOOC, Santa Rosa, and CCPA, Sacramento.

Karfiol, R. C. and L. E. McMillan (Eds.). 1983. Geysers-Calistoga KGRA-ARM Program 1981-1982 annual report, 2 vols.

Kubicek, P. F. and D. G. Price. 1976. An evaluation of water temperature and its effect on juvenile steelhead trout in geothermally active areas of Big Sulphur Creek. Cal-Nev Wildlife Transactions, J. Hoakum (Ed.), pages 1-24.

LandWatch, Incorporated. 2003. 2003 Boron drift monitoring summary for the Calpine Geothermal Power Plant # 19. Prepared for Calpine Corporation.

Lepp. N. W. (ed.). 1981. Effect of heavy metal pollution on plants. Vol. I and II, Applied Science, London.

Malloch, B. S., M. K. Eaton and N. L. Crane. 1979. Assessment of vegetation stress and damage near the Geysers power plant units. Pacific Gas and Electric, Engineering Research, Report 420-79.3, San Ramon.

Marshack, J. B. 1985. Water Quality Objectives and Hazardous and Designated Levels for Chemical Constituents. Appendix IV, California Regional Water Quality Control Board, Central Valley Region.

McKean, M.E., R.J. Brown and W.P. Jordan. 1998. Bear Canyon and West Ford Flat Monitoring Report 1997-1998 (BC/WFF X). Published by the Institute of Chemical Biology (USF) for Calpine Geysers Company, Santa Rosa, CA.

McKee, J. E. and H. W. Wolf (Eds.) 1963. Water Quality Criteria (3-a). California State Water Resources Control Board, Sacramento.

McMillan, L. E. (Ed.). 1985. Geysers-Calistoga KGRA-ARM Program 1982-1983 annual report, 2 vols.

Moyle, P. B. 2002. Inland Fishes of California, University of California Press, Berkeley and Los Angeles, CA.

Nolte and Associates. 1985. Draft Environmental Impact Report West Ford Flat (PG&E Unit 19) Project Area, Lake County, California.

Platts, W. S., W. F. Megahan, and G. W. Minshall. 1983. Methods for Evaluating Stream, Riparian, and Biotic Conditions. U.S. Forest Service, Intermountain Forest and Range Experiment Station, Gen. Tech. Report INT-138.

Thurston, R. V., R. C. Russo, C. M. Fetterrolf, T. A. Edsall and Y. M. Barber (Eds.). 1979. A review of the EPA Redbook: Quality Criteria for Water. Water Quality Section, American Fisheries Society, Bethesda.

U.S. Environmental Protection Agency (USEPA). 1980. Ambient water quality criteria for arsenic (440/5-80-201), cadmium (440/5-80-025), copper (440/5-80-036), lead (440/5-80-057), mercury (440/5-80-058), nickel (440/5-80-060), selenium (440/5-80-070) and zinc (440/5-80-079).

U.S. Environmental Protection Agency (USEPA). 1986. Quality Criteria for Water 1986. EPA 440/5-86-001. Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1988. Ambient Water Quality Criteria for Chloride - 1988. EPA 440/5-88-001. Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1999a. 1999 Update of Ambient Water Quality Criteria for Ammonia. EPA-822-R-99-014. Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1999b. National Recommended Water Quality Criteria - Correction. EPA 822-F-98-005. Office of Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 2006. National Recommended Water Quality Criteria. Office of Water, Office of Science and Technology (4304T). 440/9-76-023.

Van Deventer, S. J. and W. S. Platts. 1989. Microcomputer software system for generating population statistics *in* Electrofishing data user's guide for MicroFish 3.0. Gen Tech Rep INT-254. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 29 p.

CONDITION OF CERTIFICATION
BIOLOGICAL RESOURCES 1-3

Attachment BR 1-3b: Guzzler Inspection Report

Geysers Quicksilver Plant (Unit 16) 79-AFC-05
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020


Check dam below Sonoma


Drainage outfall below Sonoma


Injun Mine pond below Unit 16 (road down to pond is inaccessible)


Sediment pond below Unit 16


Replacement guzzler above Unit 16


Guzzler below Unit 17


Guzzler below Unit 17

Pond off Pine Flat Rd - south of Unit 18


Reconstructed "Joe Guzzler" above Unit 18


Reconstructed "Joe Guzzler" above Unit 18


Replacement guzzler east of Unit 18


Replacement guzzler east of Unit 18


Pond between Post 3 and Unit 18


Pond below Unit 20


Outlet of pond
below Unit 20

Replacement guzzler below Unit 20 ("Bathtub Guzzler")

Replacement guzzler below Unit 20 (east of steamline between U16 and 20)

CONDITION OF CERTIFICATION
PUBLIC HEALTH 6-1

Attachment PH 2-1: Table of quarterly radon-222 concentration analyses in non-condensable gases during the 2020 calendar year

Geysers Quicksilver Plant (Unit 16) 79-AFC-05
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

	1Q20	2Q20	3Q20	4Q20	Quicksilver 16
Date	03/10/20	06/30/20	07/28/20	12/2/20	
Unit	16	16	16	16	16
[Rn-222] Main Steam Sample (pCi/Kg)	**43299**	**47283**	**51238**	**46149**	
Unit gross load (MW)	**54.4**	**49.1**	**45.5**	**48**	
Supply steam flow rate (klb/hr)	**883**	**800**	**762**	**768**	
Supply Steam Flow Rate (Mg/hr)	401	363	346	348	
Steam Rate (lb/kwhr)	**15.89**	**16.28**	**16.36**	**15.81**	
Steam Rate Derived Supply Steam Flow Rate (Mg/hr)	392	363	338	344	
100% Service Cool. Tower Air flow Rate, S.T.P. (GL/hr)	21.40	21.40	21.40	21.40	
Number of Fans in Service	**11**	**11**	**11**	**9**	
Number of Fans	11	11	11	11	
Cool. Tower fract. (cells oper. /cells design)	1.00	1.00	1.00	0.82	
Cooling Tower air flow rate, S.T.P. (GL/hr)	21.40	21.40	21.40	17.51	
Unit daily Cooling Tower air flow (L/day)	5.136E+11	5.136E+11	5.136E+11	4.20218E+11	
Unit Rn222 Release Rate (Ci/day)	0.41	0.41	0.42	0.38	
Unit Rn222, Emission Concentration (pCi/L)	**0.79**	**0.80**	**0.81**	**0.91**	
Notes on Color Codes:					
Data from Sample Collection Sheet					
Data from Analytical Laboratory Results					
Data From Annual Criteria Pollutant Inventory (see *updated Generation Summary* tab)					

CONDITION OF CERTIFICATION
WQ 11-10

Attachment WQ 11-10: 2020 Geysers Power Plant Units Recycled Water Use Report

Geysers Quicksilver Plant (Unit 16) 79-AFC-05
2020 Annual Compliance Report to the California Energy Commission
January 2020-December 2020

GEYSERS POWER COMPANY, LLC
10350 Socrates Mine Road
Middletown, CA 95461
707.431.6000

GWQ-21-024

February 11, 2021

Janice Oakley, P.E.
District Engineer
State WRCB – Division of Drinking Water
50 D Street, Suite 200
Santa Rosa, CA 95404

Subject: 2020 Geysers Power Plant Units Recycled Water Use Report

Dear Ms. Oakley:

Use of Santa Rosa recycled water first began at Unit 17 on July 22, 2004 where it supports cooling tower basin levels by replacing blowdown water at a rate of 400-500 gpm. When tower basin water levels are sufficiently high, recycled water bypasses the tower and enters the onsite sediment pond, where it mixes with condensate then gravity feeds to the Unit 11 sediment pond prior to reinjection at the OS-16 well. Tabulated below are various uses of recycled water during 2020.

2020 Total	U17 Tower	U20 Tower	Unit 7/8 Sediment Pond	Aidlin Injection and/or Burner
Gallons	144,809,847	109,083,331	188,903,650	69,621,026

Minor amounts of recycled water were used for incidental purposes as identified in Section 3.2 of the Engineering Report. These uses may consist of dust control, construction, fire-fighting and industrial process water. Additionally, recycled water was used for various drilling activities in Sonoma County during 2020. Appropriate signage and labeling was directed by the User Supervisor for these activities.

If you have any questions, please contact me at (707) 431-6097.

Sincerely,

Bill King
Calpine-Geysers EHS